



THE JOHNS HOPKINS UNIVERSITY
STUDIES IN GEOLOGY

No. 15

EDITED BY
JOSEPH T. SINGEWALD, JR.

**MESOZOIC FOSSILS
OF THE
PERUVIAN ANDES**

BY
MAXWELL M. KNECHTEL, EDWARD F. RICHARDS
and MARY V. RATHBUN

Ellsworth Expedition Publication

BALTIMORE
THE JOHNS HOPKINS PRESS

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PART I

INTRODUCTION

by

MAXWELL M. KNECHTEL AND EDWARD F. RICHARDS

LIST OF COLLECTIONS

DESCRIPTION OF COLLECTION LOCALITIES

by

JOSEPH T. SINGEWALD, JR.

PART I

INTRODUCTION

By MAXWELL M. KNECHTEL AND EDWARD F. RICHARDS

The following descriptions of Peruvian Mesozoic fossils in collections of The Johns Hopkins University and the United States National Museum were prepared in 1927 and 1928 as dissertations for the degree of Doctor of Philosophy at The Johns Hopkins University. Most of the collections were obtained by expeditions led by Dr. Joseph T. Singewald, Jr., in 1924 and 1925 (58, 59, 60)*. Their publication now is timely since it will render the collections readily usable for comparative purposes in current studies of more extensive and more recent collections of South American Mesozoic fossils. The authors are indebted to the late Dr. E. W. Berry, under whose direction the paleontological studies were carried on; to Dr. J. B. Reeside, Jr., of the Geological Survey, for much helpful counsel; to Dr. T. W. Stanton, of the Geological Survey, and Dr. R. S. Bassler, of the United States National Museum, for providing facilities for carrying on the work; and to Dr. Ralph W. Imlay, of the Geological Survey, for aiding in the final preparation of the manuscript.

In stratigraphic correlations and age determinations, ammonites are generally considered more satisfactory than pelecypods, gastropods and echinoids and are used preferentially in the present work. The types of all the new ammonite species and at least one representative of each of the other ammonite species in the collections are deposited with the Department of Geology of The Johns Hopkins University, and the remainder are in the United States National Museum. Some additional ammonites collected by J. A. Sinclair and T. Wasson from the Albian beds of the same region are also described; these are in Collections 11340 and 11341 at the National Museum.

The ammonites described fall into four categories, according to age. A small and, on the whole, poorly preserved assemblage of forms has been assigned to the genus *Perisphinctes*, using that name in an inclusive sense, and the beds containing them are, following previous writers, referred to the Tithonian. A single ammonite species, *Knemiceras bassleri*, n. sp., must be considered to be Aptian because of its association, in Collection 317,

* Numbers in parentheses refer to the bibliography.

with pelecypods and echinoids that are referred to the Aptian, as further explained below. A rather large and well preserved lot belongs to the Middle Albian of the European continental section, or Lower Gault of the British section. It comprises the genera *Oxytropidoceras*, *Mojsisovicsia*, *Brancoceras*, *Knemiceras*, and *Douvillieceras*. Finally, a group in which are represented the genera *Tissotia*, *Heterotissotia*, *Barroisiceras*, *Buchiceras*, *Lenticeras*, *Eulophoceras*, and *Desmophyllites* indicates that the beds from which these fossils were collected are of Senonian age, and the occurrence of the genus *Tissotia* at nearly all of the Senonian localities suggests that they may all be of Coniacian age.

In addition to the ammonites, the collections while fairly rich in individuals, have yielded a total of only fifty-five species, comprising pelecypods, gastropods and echinoids, and a shrimp-like decapod crustacean. This material is, for the most part, in a poor state of preservation and identifications of many specimens must be considered tentative, but it is hoped that the identifications, descriptions and illustrations will lead to more conclusive results when seen by others who may have the good fortune to work with better material.

One gastropod and a number of pelecypods, of which all except two species are new, occur in the beds containing the Middle Albian ammonite assemblage cited above. In these beds the following pelecypod species are represented: *Nucula pongensis*, n. sp., *Arca knechteli*, n. sp., *Inoceramus concentricus* Parkinson, *Exogyra* n. sp. aff. *E. africana* Coquand, *Protocardia meridionalis* n. sp., *Paphia peruana* n. sp., *Epitonium pongensis* n. sp., *Plicatula singerwaldi* n. sp., *Pholadomya pongensis* n. sp., *Liopistha* sp. aff. *L. gigantea* Sowerby, *Exogyra flabellata* Goldfuss, *Exogyra* sp. indet., *Protocardia berrii* n. sp., *Natica* sp. indet.

A small number of pelecypods and echinoids, with which is associated the new ammonite species *Knemiceras bassleri*, has been referred to the Aptian. Some of the pelecypods in this assemblage are identified with forms previously described from South America which have long been considered identical with Aptian species of Spain, Portugal and northern Africa. The echinoids are less indicative. Although some of them belong to species that have been described from the Aptian of neighboring areas, the species are not restricted to that age. All of the species range into the Albian and one extends to the Lower Senonian.

The remaining species of pelecypods and echinoids occur at localities at which Senonian ammonites were collected and are, without exception, regarded as Lower Senonian species. *Ostrea nicaisei* Coquand and *Pholadomya quinuana* Neumann have been considered to be typical of the

Santonian and Campanian. The presence of the latter species suggests that possibly the most accurate, though most general, age determination should be extended to include the whole of the Emscherian, but the presence of the ammonites, and especially of the genus *Tissotia*, makes it seem probable that the age of the beds containing this assemblage is Coniacian.

LIST OF COLLECTIONS

COLLECTION NUMBER	SPECIES	INDICATED AGE
1	<i>Knemiceras attenuatum</i> (Hyatt) Krause. do. var. <i>spinosa</i> Sommermeier. <i>Knemiceras semicostatum</i> Sommermeier. <i>Knemiceras crassicoatum</i> Sommermeier. <i>Knemiceras raimondi</i> Lisson. <i>Knemiceras moorei</i> Knechtel, n. sp. <i>Knemiceras</i> (undetermined species). <i>Lyelliceras ulrichi</i> Knechtel, n. sp. <i>Lyelliceras mathewsi</i> Knechtel, n. sp. <i>Brancoceras</i> (undetermined species). <i>Oxytropidoceras douglasi</i> Knechtel, n. sp. <i>Oxytropidoceras</i> (<i>Manuaniceras</i>) <i>carbonarium</i> (Gabb). <i>Oxytropidoceras</i> (<i>Manuaniceras</i>) <i>bösei</i> Knechtel, n. sp. <i>Oxytropidoceras</i> (<i>Manuaniceras</i>) <i>hubbardi</i> Knechtel, n. sp. <i>Nucula pongensis</i> Richards, n. sp. <i>Arca Knechteli</i> Richards, n. sp. <i>Arca megumbona</i> Richards, n. sp. <i>Inoceramus concentricus</i> Parkinson. <i>Exogyra</i> n. sp. aff. <i>E. africana</i> Coquand. <i>Protocardia</i> n. sp. aff. <i>P. hillana</i> (Sowerby). <i>Protocardia meridionalis</i> Richards, n. sp. <i>Paphia peruana</i> Richards, n. sp. <i>Epitonium pongensis</i> Richards, n. sp. <i>Plicatula singewaldi</i> Richards, n. sp. <i>Pholadomya pongensis</i> Richards, n. sp. <i>Liopistha</i> sp. aff. <i>L. gigantea</i> Sowerby.	Middle Albian
16	<i>Tissotia reesideana</i> Knechtel, n. sp.	Coniacian
26	<i>Barroisiceras grossowreii</i> Knechtel, n. sp.	Senonian
27	<i>Tissotia reesideana</i> Knechtel, n. sp. <i>Tissotia steinmanni</i> Lisson. <i>Tissotia obesa</i> Knechtel, n. sp.	Coniacian
30	<i>Tissotia compressa</i> Knechtel, n. sp. <i>Tissotia</i> (undetermined species). <i>Cardium watsoni</i> Richards, n. sp. (?)	Coniacian

COLLECTION NUMBER	SPECIES	INDICATED AGE
31	<i>Tissotia singewaldi</i> Knechtel, n. sp. <i>Tissotia andii</i> Knechtel, n. sp. <i>Tissotia roscheni</i> Knechtel, n. sp. <i>Tissotia obesa</i> Knechtel, n. sp. <i>Tissotia</i> (undetermined species).	Coniacian
33	<i>Tissotia reesideana</i> Knechtel, n. sp. <i>Tissotia singewaldi</i> Knechtel, n. sp. <i>Tissotia waltheri</i> Knechtel, n. sp. <i>Tissotia compressa</i> Knechtel, n. sp. do. var. <i>levis</i> Knechtel, n. var. <i>Desmophyllites ellsworthi</i> Knechtel, n. sp.	Coniacian
34	<i>Tissotia compressa</i> Knechtel, n. sp. do. var. <i>levis</i> Knechtel, n. var. <i>Tissotia</i> (undetermined species). <i>Pholadomya</i> sp.	Coniacian
35	<i>Tissotia singewaldi</i> Knechtel, n. sp. <i>Tissotia</i> (undetermined species). <i>Lenticeras lissoni</i> Knechtel, n. sp. <i>Cucullaea andersoni</i> Richards, n. sp.	Coniacian
36	<i>Tissotia reesideana</i> Knechtel, n. sp. <i>Tissotia singewaldi</i> Knechtel, n. sp. <i>Tissotia stephensoni</i> Knechtel, n. sp. <i>Tissotia</i> (undetermined species). <i>Fusinus</i> sp. indet.	Coniacian
37	<i>Tissotia reesideana</i> Knechtel, n. sp. <i>Tissotia stephensoni</i> Knechtel, n. sp. <i>Tissotia obesa</i> Knechtel, n. sp. <i>Tissotia</i> (undetermined species). <i>Eulophoceras berryi</i> Knechtel, n. sp.	Coniacian
38	<i>Tissotia reesideana</i> Knechtel, n. sp. <i>Tissotia steinmanni</i> Lisson. <i>Tissotia compressa</i> Knechtel, n. sp. var. <i>levis</i> Knechtel, n. var. <i>Tissotia</i> (undetermined species). <i>Heterotissotia lissoni</i> Knechtel, n. sp. <i>Cucullaea reesideana</i> Richards, n. sp.	Coniacian
42	<i>Tissotia andii</i> Knechtel, n. sp. <i>Tissotia roscheni</i> Knechtel, n. sp. <i>Tissotia obesa</i> Knechtel, n. sp. <i>Buchiceras bilobatum</i> Hyatt emend. Brüggen. <i>Roudairia intermedia</i> Brüggen.	Coniacian

COLLECTION NUMBER	SPECIES	INDICATED AGE
44	<i>Plicatulopecten böhmi</i> Neumann. <i>Hemiasterourneli</i> var. <i>obliquus</i> Brüggen.	Santonian ?
46	<i>Ostrea nicaisi</i> Coquand. <i>Plicatulopecten böhmi</i> Neumann. <i>Lima ellsworthi</i> Richards, n. sp. <i>Pholadomya quinuana</i> Neumann. <i>Hemiasterourneli</i> var. <i>obliquus</i> Brüggen. <i>Turritella</i> sp. indet.	Emscherian
49	<i>Tissotia obesa</i> Knechtel, n. sp. <i>Tissotia halli</i> Knechtel, n. sp.	Coniacian
50	<i>Tissotia singewaldi</i> Knechtel, n. sp. <i>Barroisiceras brüggeni</i> Knechtel, n. sp. <i>Plicatulopecten böhmi</i> Neumann. <i>Pholadomya quinuana</i> Neumann. <i>Hemiasterourneli</i> var. <i>obliquus</i> Brüggen. <i>Turritella</i> sp. indet.	Santonian
51	<i>Tissotia steinmanni</i> Lisson. <i>Lenticeras gerhardti</i> Knechtel, n. sp. <i>Lenticeras baltæ</i> Lisson. <i>Plicatulopecten böhmi</i> Neumann. <i>Cardium centralis</i> Richards, n. sp. <i>Hemiasterourneli</i> var. <i>obliquus</i> Brüggen. <i>Turritella</i> sp. indet.	Coniacian
117	<i>Trigonia hondaana</i> Lea. <i>Trigonia matthewsi</i> Richards, n. sp.	Aptian ?
133	<i>Knemiceras crassinodosum</i> Sommermeier. <i>Knemiceras</i> (undetermined species).	Middle Albian
134	<i>Turritella roscheni</i> Richards, n. sp.	?
163	<i>Perisphinctes</i> cf. <i>contiguus</i> (Catullo) Zittel. <i>Perisphinctes</i> cf. <i>gevreyi</i> Toucas. <i>Perisphinctes</i> cf. <i>pouzinsensis</i> Toucas. <i>Perisphinctes</i> cf. <i>tiziani</i> Oppel. <i>Perisphinctes</i> sp. <i>Perisphinctes</i> (undetermined species).	Tithonian
165	<i>Oxytropidoceras?</i>	Middle Albian
166	Rock containing <i>Lyelliceras</i> and <i>Brancoceras</i>	Tithonian
174	<i>Perisphinctes</i> (undetermined species).	Tithonian
205	<i>Trigonia matthewsi</i> Richards, n. sp.	Aptian

COLLECTION NUMBER	SPECIES	INDICATED AGE
307 ?	<i>Tissotia</i> (undetermined species).	Coniacian ?
307	<i>Pinna decussata</i> Goldfuss? <i>Inoceramus</i> sp. <i>Ostrea nicaisei</i> Coquand <i>Plicatulopecten ferryi</i> var. <i>concentricus</i> Brüggen. <i>Cardium watsoni</i> Richards, n. sp. <i>Cardium centralis</i> Richards, n. sp. <i>Natica lesseli</i> Brüggen. <i>Natica</i> cf. <i>N. larteti</i> Landerer. <i>Natica</i> n. sp. <i>Volutolithes</i> ? sp. indet.	Emscherian
310	<i>Knemiceras semicostatum</i> Sommermeier. <i>Exogyra flabellata</i> Goldfuss	Middle Albian
316	<i>Douvilleiceras</i> sp. <i>Exogyra</i> sp. indet. <i>Protocardia berrii</i> Richards, n. sp. <i>Natica</i> sp. indet.	Middle Albian
317	<i>Knemiceras bassleri</i> Knechtel, n. sp. <i>Nucula turgida</i> Richards, n. sp. <i>Cucullaea gabrielis</i> Leymerie <i>Exogyra</i> sp. indet. <i>Trigonia subcrenulata</i> d'Orbigny. <i>Pecten morrisi</i> Pictet and Renevier. <i>Lima silinensis</i> Richards, n. sp. <i>Modiola silinensis</i> Richards, n. sp. <i>Pholadomya silinensis</i> Richards, n. sp. <i>Anatina silinensis</i> Richards, n. sp. <i>Liopistha</i> sp. aff. <i>L. alta</i> Römer. <i>Holcotypus planatus</i> var. <i>numismalis</i> Gabb. <i>Enallaster peruanus</i> Gabb. <i>Enallaster roscheni</i> Richards, n. sp. <i>Botriopygus compressus</i> Gabb.	Aptian
318	<i>Lyelliceras ulrichi</i> Knechtel, n. sp. <i>Lyelliceras mathewsi</i> Knechtel, n. sp. <i>Brancoceras aegoceratoides</i> Steinmann.	Middle Albian
320	<i>Perisphinctes</i> cf. <i>contiguus</i> (Catullo) Zittel. <i>Perisphinctes</i> aff. <i>densistriatus</i> Steuer. <i>Perisphinctes</i> cf. <i>pouzinensis</i> Toucas. <i>Perisphinctes</i> (undetermined species).	Tithonian
321	<i>Perisphinctes</i> cf. <i>pouzinensis</i> Toucas. <i>Perisphinctes</i> (undetermined species).	Tithonian

COLLECTION NUMBER	SPECIES	INDICATED AGE
322	Pebbles containing <i>Perisphinctes</i> (undetermined species).	Tithonian ?
327	<i>Anisocardia</i> ? sp. indet.	?
348	<i>Oxytropidoceras douglasi</i> Knechtel, n. sp. <i>Liopistha</i> sp. aff. <i>L. gigantea</i> Sowerby.	Middle Albian
11340	<i>Knemiceras attenuatum</i> (Hyatt) Krause var. <i>spinosa</i> Sommermeier. <i>Knemiceras semicostatum</i> Sommermeier. <i>Knemiceras sommermeieri</i> Knechtel, n. sp. <i>Knemiceras crassicostatum</i> Sommermeier. <i>Knemiceras crassinodosum</i> Sommermeier. <i>Knemiceras moorei</i> Knechtel, n. sp. <i>Knemiceras</i> sp. <i>Knemiceras</i> (undetermined species). <i>Lyelliceras ulrichi</i> Knechtel, n. sp. <i>Brancoceras quenstedti</i> Knechtel, n. sp. <i>Mojsisovicsia gabbi</i> Knechtel, n. sp. <i>Oxytropidoceras douglasi</i> Knechtel, n. sp. <i>Oxytropidoceras</i> (<i>Manuaniceras</i>) <i>carbonarium</i> (Gabb). <i>Oxytropidoceras</i> (<i>Manuaniceras</i>) <i>bösei</i> Knechtel, n. sp. <i>Callianassa peruviana</i> Rathbun, n. sp.	Middle Albian
11341	<i>Oxytropidoceras</i> (<i>Manuaniceras</i>) <i>carbonarium</i> (Gabb).	Middle Albian

DESCRIPTION OF COLLECTION LOCALITIES

By JOSEPH T. SINGEWALD, JR.

PONGO DE MANSERICHE, RIO MARANON, LORETO (59).

Collection 6. ($77^{\circ} 35' E$, $4^{\circ} 26' S$)* On the north bank of the river, 1100 feet downstream from the contact of the Pongo Sandstone and the Shale-Limestone series, in a small quebrada and for 100 feet or more downstream, are exposures of fossiliferous beds. They vary from gray clay-shale, weathering with nodular fracture, to highly bituminous, nearly black calcareous shale, to black limestone with a strong odor of petroleum on fresh fracture surfaces. Intercalated in the shales are calcium carbonate nodules and limestone beds up to 3 feet thick. Overlying these fossiliferous beds is white quartzitic sandstone.

Collection 16. ($77^{\circ} 35' E$, $4^{\circ} 26' S$) On the north bank of the river, about 2000 feet upstream from the Huacanqui whirlpool. From limestone debris along the bank.

RIO AICHYACU, LORETO

The Rio Aichiyacu is a tributary of the Rio Potro which enters the Rio Maranon from the southwest about 15 miles upstream from Barranca.

Collection 26. ($77^{\circ} 14' E$, $5^{\circ} 1' S$) The locality is about 25 miles south of west of the confluence of the Rio Aichiyacu and the Rio Potro. The outcropping formations are the lower Red Beds, with salt intercalations and from which sulphurous hot waters issue. Fossiliferous light gray limestone boulders indicate outcroppings of the Shale-Limestone series further upstream. The collection was obtained from these boulders.

PETRONILA, RIO UCAYALI, LORETO

Petronila is on the east bank of the Rio Ucayali, about 10 miles upstream from Paca, where the Shale-Limestone series of the Contamana Mountains reaches the Rio Ucayali.

* Latitudes and longitudes are positions on the American Geographic Society 1:1 000 000 map.

Collection 27. ($74^{\circ} 59' \text{ E}$, $6^{\circ} 59' \text{ S}$) About 300 feet south of the sugar mill at Petronila, and nearly 100 feet south of the arroyo, is a landslip exposing massive to bedded, light gray, soft, friable sandstone. Under the sandstone is well-bedded, fossiliferous, lead-gray clay shale. These beds are in the Shale-Limestone series under the Haucanqui sandstone.

RIO SARAYAQUILLO (SARAYACU), LORETO

The Rio Sarayaquillo flows in a direction a little north of east, on the west side of the Rio Ucayali, into which it empties about 1 mile downstream from Paca. The lower course of the river to Santa Rosa about 22 miles west of Paca ($75^{\circ} 4' \text{ E}$, $6^{\circ} 55' \text{ S}$) is through the upper Red Beds. Upstream from Santa Rosa the Red Beds are in fault contact with the Shale-Limestone series on the eastern limb of an anticline exposing the Pongo sandstone. Upstream from the Pongo Sandstone the river traverses for about six miles a syncline in the Shale-Limestone series.

Collection 30. About $\frac{1}{4}$ mile downstream from the contact of the Pongo sandstone and the Shale-Limestone series, on the east limb of the anticline, extending along the river about 200 feet, is gray to blue-gray shale ranging from pure, platy shale to fine sandy and irregular bedded shale with harder intercalations of fossiliferous calcareous beds usually containing shale pebbles.

Collection 31. About 1 mile upstream from the contact of the Pongo sandstone and the Shale-Limestone series, on the west limb of the anticline and about $\frac{1}{5}$ mile upstream from Quebrada Lacre, are outcrops of lead-gray, fairly well-bedded fossiliferous shale with occasional intercalations less than 1 inch thick of sandy limestone.

RIO CUXIABATAY (CUSHABATAY), LORETO

The Rio Cuxiabatay and its tributaries head in a region west of a group of high mountains that separates them from the headwaters of the Rio Sarayaquillo. They flow in a southerly to southeasterly direction, and their confluence turns easterly around the south end of these high mountains and continues easterly to the Ucayali River at Pampa Hermosa ($75^{\circ} 7' \text{ E}$, $7^{\circ} 13' \text{ S}$).

Upstream to a large fork of the Rio Cuxiabatay at $75^{\circ} 31' \text{ E}$, $7^{\circ} 4' \text{ S}$, the river flows through the Red Beds. The branch coming from the north is herein called the Rio Cuxiabatay (the Aguanuya of the American Geographic Society map), and the branch coming from the north-northwest is herein called the Rio Ochpayacu (the Cushabatay of the American Geo-

graphic Society map). One mile above the confluence of these two rivers, the Rio Cuxiabatay enters the Shale-Limestone series, traverses the upper beds for a mile and then flows over the Huacanqui sandstone. About 3 miles above the confluence, in the Huacanqui sandstone, the Rio Agua Blanca enters from the northwest. On both the Rio Cuxiabatay and the Rio Agua Blanca, the Huacanqui sandstone is succeeded upstream by the lower beds of the Shale-Limestone series. The Rio Cuxiabatay flows across these beds for a distance of about 5 miles, and the Rio Agua Blanca about 7 miles. Further upstream both rivers traverse for long distances an area underlain by Pongo sandstone.

Collections 33, 34, and 35 are from the Rio Cuxiabatay from beds in about the middle of the lower beds of the Shale-Limestone series.

Collection 33. An exposure of 30 feet of dark gray to black, soft, thin-bedded shale which weathers to angular and thin flaky fragments and contains sparingly small calcareous and pyritic concretions.

Collection 34. About $\frac{1}{4}$ mile further upstream, an exposure of 40 feet of dark gray, soft, fissile shale with thick intercalations of lighter gray, hard, sandy shale.

Collection 35. At the east end of a sharp easterly bend of the river, about $\frac{1}{2}$ mile further upstream, an exposure of 40 feet of light gray, fine to medium-grained sandy shale.

Collections 36, 37, 38 extend over a wider stratigraphic range in the lower part of the Shale-Limestone series along the Rio Agua Blanca.

Collection 36. An exposure of dark gray, fissile shale extending $\frac{1}{4}$ mile along the river.

Collection 37. About 1 mile further upstream, an exposure of 40 feet of dark gray to black, soft, thin-bedded shale with small calcareous and pyritic concretions. This is probably the same horizon as at the locality of Collection 33.

Collection 38. Nearly 2 miles further upstream, exposures of about 75 feet of interbedded dark gray, fissile shale and fossiliferous, light gray, hard sandy shale.

RIO PACHITEA, HUANUCO (60)

The Shale-Limestone series outcrops in two areas along the Rio Pachitea, in the vicinity of Isla de Chonta ($74^{\circ} 41' \text{ E}$, $8^{\circ} 52' \text{ S}$) and from Baños ($74^{\circ} 52' \text{ E}$, $9^{\circ} 6' \text{ S}$) to beyond Esperanza ($74^{\circ} 54' \text{ E}$, $9^{\circ} 12' \text{ S}$).

Collection 42. The upstream half of the Isla de Chonta and the opposite banks of the river are underlain by gray shale that breaks down into nodular

fragments on weathering and fossiliferous harder impure limestone that weathers to a gray-white color.

Collection 44. About $\frac{1}{4}$ mile downstream from the Quebrada Baños is light blue-gray to olive-gray shale that weathers to a pearl-gray color, with intercalations of nodular, argillaceous limestone beds less than one foot thick at intervals of several feet. A few of the intercalated harder beds are calcareous sandstone.

Collection 46. About $\frac{3}{5}$ mile upstream from Quebrada Baños, is nodular gray shale that breaks into small fragments on weathering, in which are intercalations about 2 feet thick of thin-bedded, nodular, argillaceous limestone.

Collection 49. A half mile downstream from the Quebrada Santa Teresa, 2 miles north of Esperanza, are alternating beds of blue-gray, thin-bedded shale, pale green-gray and gray nodular shale, and nodular, argillaceous limestone that weathers to a dirty white color in beds from a few inches to four feet in thickness.

Collection 50. From a half mile upstream from the Quebrada Santa Teresa to a half mile downstream from the Quebrada Estala, for a distance of about a half mile, is blue-gray to slate-gray, thin-bedded shale that breaks down to small flakes on weathering, intercalated in which are nodular, gray limestone and bands of limestone concretions from 1 to 3 inches in diameter at intervals of about six inches. Fossils are abundant in these beds.

Collection 51. A half mile upstream from the Quebrada Estala and nearly 1 mile downstream from the Rapidos de Sira, is blue-gray to slate-gray shale with widely spaced intercalations of nodular, argillaceous limestone beds and layers of limestone nodules. The character of the shale varies with its calcareousness. The less calcareous the shale, the darker the shade of gray and the greater the tendency to platiness and fissility on weathering. The more calcareous beds are lighter gray in color and tend to have a more nodular or irregular fracture.

The stratigraphic position of Collection 42 is uncertain. The nearly one mile wide band of the Shale-Limestone series at the Isla de Chonta is in fault contact with the Pongo sandstone on its upstream side and is probably in fault contact with the Red Beds on the downstream side. It does not include the horizon of the Huacanqui sandstone.

Collections 44, 46, 49, 50, and 51 are from the Shale-Limestone series below the Huacanqui sandstone. The probable stratigraphic position of these localities downward is: Collection 49; Collections 50 and 51; Collection 46; Collection 44.

HUAILAS, ANCACHS ($77^{\circ} 54' \text{ E}$, $8^{\circ} 52' \text{ S}$)

At the eastern outskirts of Huailas along the road to Caras is a series of intercalated beds of limestone and shale which include beds of gypsum. Limestone from several small quarries is burned for lime.

Collection 117. Along the road, 0.7 mile east of the Huailas plaza, is dark gray shale that weathers to small fragments with intercalations of thin beds of fossiliferous limestone and calcareous shale.

Collection 205. From similar fossiliferous beds in the same vicinity.

SICSABAMBA (SICSIBAMBA), ANCACHS ($77^{\circ} 36' \text{ E}$, $8^{\circ} 37' \text{ S}$)

Collection 113. About $\frac{1}{2}$ mile southwest of Sicsabamba on the road to the Hacienda Cochabamba are fossiliferous limestones which overlie thin-bedded, white quartzites with interbedded mashed coal seams, and which are in turn overlain by black shale and olive shale with intercalations of fossiliferous nodular-fracturing limestone.

Collection 134. Between Sicsabamba and Parias ($77^{\circ} 36' \text{ E}$, $8^{\circ} 34' \text{ S}$) the road descends to a bridge across the Rio Sihuas at Tumaringa and then ascends on the opposite side to Parias. The Rio Sihuas has cut a gorge in an anticline of quartzites the axis of which runs along the Rio Sihuas in the direction $\text{N } 45^{\circ} \text{ W}$ and pitches steeply in the same direction. The beds on the southwest limb dip 18° and those on the northeast limb dip 47° . Toward the top of the quartzites are intercalations of shale some of which is red and green in color and which breaks into nodular fragments. Overlying the quartzites is fossiliferous, dark blue limestone in beds up to 3 feet in thickness with bands of black chert. Fossils are abundant in these limestones on both limbs of the anticline.

ACO, ANCACHS ($77^{\circ} 53' \text{ E}$, $8^{\circ} 31' \text{ S}$)

Between Cabana ($78^{\circ} 1' \text{ E}$, $8^{\circ} 24' \text{ S}$) and Aco are blue-black slates showing prismatic metamorphic minerals intruded by stocks and dikes of biotite granite and hornblende diorite.

Collection 163. About halfway between Cabana and Aco are fossiliferous blue-black slates.

Between Aco and Urcon ($77^{\circ} 47' \text{ E}$, $8^{\circ} 34' \text{ S}$) are the blue-black slates.

Collection 165. On the mountain side above the Hacienda Yantacon, nearly halfway between Aco and Urcon, are fossiliferous blue-black slates.

SIHUAS, ANCACHS (77° 38' E, 8° 33' S)

Collection 166. One mile west of the plaza in Sihuas, a small branch of the Rio Sihuas flowing in a north-northeasterly direction crosses alternating beds of shale, sandstone, and quartzite. Where the road to Tarica crosses this stream the beds dip to the south. In the bed of the stream is much debris of dark blue fossiliferous limestone brought down from higher up on the mountain. Collection 166 is from this limestone debris.

TARICA, ANCACHS (77° 45' E, 8° 36' S)

In the vicinity of the Urpay coal mine, $1\frac{3}{4}$ miles southeast of Tarica, are interbedded blue-black slaty shale and dark gray and white quartzite containing coal seams.

Collection 174. At the sharp bend in the road to Tarica, $\frac{1}{4}$ mile west of the Urpay mine, the shale is fossiliferous.

QUILLAR, RIO RUPAC, ANCACHS (77° 27' E, 8° 35' S)

Along this portion of the Rio Rupac is a highly folded series of alternating beds of limestone, calcareous shale, and gray shale.

Collection 307. The San Pedro house of the Hacienda Santa Clara is $1\frac{1}{2}$ miles down the Rio Rupac from Quillar, on the north side of the river and on the downstream side of a small branch of the river. About 800 feet northeast of the house and about 90 feet higher than the house is a group of highly fossiliferous beds consisting of nodular, marly limestone that weathers tan, and pale gray calcareous shale that weathers to small irregular fragments.

CHACABAMBA, RIO RUPAC (77° 23' E, 8° 33' S)

The Rio Rupac continues to traverse highly folded beds of limestone, calcareous shale and shale. The limestones are prevailingly dove-gray in color and range from massive hard beds, to nodular fracturing argillaceous beds, to softer marly beds. The shales range from thin-bedded to nodular fracturing. There are also occasional intercalations of thin-bedded white quartzitic sandstone that tends to weather to a dark rusty color.

Collection 310. At the Rio Rupac, 1200 feet northeast of Chacabamba, are fossiliferous beds ranging in composition from hard, nodular fracturing limestone, to argillaceous nodular limestone, to nodular fracturing shale.

PARIAS, RIO RUPAC, ANCACHS (77° 36' E, 8° 34' S)

The Rio Taullagon enters the Rio Rupac from the southwest $\frac{1}{4}$ mile upstream from Parias and $2\frac{1}{4}$ miles downstream from Sihuas. For a little over a half mile from its confluence with the Rio Rupac, the Rio Taullagon traverses a thick series of quartzites with thin intercalations of shale. The quartzite is prevailingly white, but is highly speckled with minute black pin point dots. Some of the quartzite beds, however, are dark gray and greenish yellow in color. The shale ranges in color from pearl gray to yellowish olive. Some beds fracture in nodular fragments and others into flat splintery fragments.

Overlying the quartzite beds are beds of shale and limestone. In the lower beds shale predominates over limestone, but these beds are overlain by thick beds of highly fossiliferous limestone that begin $\frac{3}{4}$ mile upstream from the mouth of the river. The dip of these beds is about 50° to the south. *Collection 316.* The lowermost beds of the thick-bedded limestone.

Collection 317. Thick beds of marly limestone intercalated with nodular fracturing shale. These beds are about 400 feet higher stratigraphically than those of Collection 316.

Collection 318. Limestone debris in the bed of the stream between the localities of Collections 316 and 317.

CAJAS, ANCACHS

Cajas is a little over 3 miles south of Quillar (77° 27' E, 8° 35' S) on the road from Sihuas to Parobamba, less than $\frac{1}{4}$ mile west of the branch road to the north to San Pedro and Santa Clara and about 7 miles northwest of Parobamba (77° 23' E, 8° 43' S).

The Sihuas-Parobamba road for a long distance on each side of Cajas traverses a series of intercalated quartzites and shales. The quartzites range from white quartzites with abundant minute black and rusty spots to gray and tan quartzitic sandstones that weather rusty colored. The shales vary from highly arenaceous to highly argillaceous, and in color from iron-black to light gray. In places the black shales contain an abundance of iron carbonate concretions ranging in size from a fraction of an inch to a foot or more in diameter. These beds also include thin, highly mashed coal beds. Such coal beds are exposed on the hillside above the road immediately southwest of Cajas.

Collection 320. Along the road, $1\frac{1}{4}$ miles northeast of Cajas, are fossiliferous, thin bedded shales with carbonate concretions and intercalations of quartzitic sandstone.

Collection 321. Along the road, $\frac{1}{2}$ mile northeast of Cajas and 1200 feet northeast of a small roadside shrine.

Collection 322. At a bridge, $1\frac{1}{4}$ miles southwest of Cajas, in fossiliferous black shale with carbonate concretions so abundant at some horizons to coalesce into continuous beds and with quartzite intercalations.

MATIBAMBA, RIO MARAÑON, ANCACHS ($77^{\circ} 13' E$, $8^{\circ} 41' S$)

Matibamba is the old crossing of the Rio Marañon on the road from Parobamba to Huacrachuco ($77^{\circ} 3' E$, $8^{\circ} 39' S$), which is at a point $1\frac{1}{2}$ miles upstream from the confluence of the Rio Parobamba.

The series of quartzites and interbedded shales described at Cajas continues along the road to Muchcayo, $2\frac{1}{4}$ miles beyond Parobamba. At Muchcayo, the road down the Rio Parobamba valley traverses a series of alternating massive limestones and shales. Both series of beds dip southwesterly so that the limestones underlie the quartzite. However, the quartzite beds are highly folded near the contact and appear to have been thrust over the limestones, perhaps on the limb of an overturned fold. The limestones are much folded with many reversals of dip, but the prevailing dip is southwesterly as at the contact with the quartzites. About $1\frac{1}{2}$ miles northeast of Muchcayo begins a series of red beds likewise much folded but with a prevailing southwesterly dip. These red beds continue down the valley for $2\frac{1}{2}$ miles to within less than 3 miles from the Rio Marañon. They consist mainly of hard red shale that weathers into pencillate fragments and includes zones of green shale. In about the middle of the series is a bed of light gray limestone, 1 foot thick underlain by several beds 1 inch thick intercalated in red and green shale. A short distance northeast of the limestone beds, the red shale has small flat lenticular cavities along the bedding planes, with the major axis rarely longer than 1 inch, which are lined with minute gypsum crystals.

East of the red beds are green chloritic schists that are highly crinkled and traversed by abundant layers and veins of white quartz. At the contact the schists have a southwesterly dip and dip under the red beds, but at a considerably steeper angle. The contact is not concordant, but may be either an unconformity or a fault contact. The schists continue to within a little more than a half mile from the Rio Marañon where they are unconformably overlain by massive, medium coarse to coarse pebbly, cross-bedded quartzitic sandstone with a steep northeasterly dip parallel to the contact surface, suggesting a basal sandstone deposited on the schists. On the other hand, at this contact on the Rio Parobamba, a zone 50 feet wide of highly mashed schist enclosing huge blocks of the sandstone, indicates

that the contact is a fault. Overlying the sandstone is thin-bedded dark shale with occasional intercalations of ferruginous limestone and quartzitic sandstone. Stratigraphically higher the limestone beds increase in abundance and thickness, and at the Rio Marañon the sequence is wholly limestone except for a few thin intercalations of calcareous shale with carbonate concretions. The limestone beds range up to several feet in thickness and are mostly dense textured and massive. Interbedded with them are nodular fracturing and breccia beds. These limestones contain sparingly poorly preserved fossils which are mostly pelecypods. This whole series of beds and the schist contact are well exposed along the Rio Parobamba, just above its confluence with the Rio Marañon. Between the mouth of the Rio Parobamba and the Matibamba crossing the rock under the pebbly sandstone is granite gneiss which extends across the Rio Marañon at Matibamba.

Collection 327. About 200 yards above the mouth of the Rio Parobamba are fossiliferous nodular-textured limestones interbedded in shale. These beds are in the shaly portion of the sequence between the pebbly sandstone and the massive limestones.

PUEBLO VIEJO, HUANUCO (76° 58' E, 8° 41' S)

About $\frac{3}{4}$ mile southwest of Pueblo Viejo, the road crosses a bridge. On the east side of the bridge a road branches to the south. About 500 feet south of this road fork is green chloritic schist. Overlying the schist and parallel to its schistosity is dark brick-red material that contains fragments of the schist. This is followed by two feet of slickensided red shaly material. This is overlain by a red coarse quartz-pebble conglomerate which becomes sandier toward the top and loses its red color, grading into a white, medium to fine-grained, pebbly sandstone which extends beyond the fork along the main road. The latter is overlain by about 20 feet of light tan, arkosic, conglomeratic sandstone blotched with rusty stains. This in turn is overlain by about 20 feet of gray shale with thin sandstone intercalations becoming mainly sandstone at the top. These beds have a northeasterly dip of about 26°. About 500 feet east of the bridge, the sandstones are succeeded by massive limestones which continue to the nose of the hill around which the stream and the road turn near Pueblo Viejo. Well around this turn the limestone appears to be faulted out and is succeeded by medium to coarse-grained, cross-bedded red sandstone with pebbly bands and this in turn in a short distance by chloritic schist with layers and veins of white

quartz. A little further to the southeast the limestone is faulted against the schist.

Collection 348. Intercalated in the massive limestones, about $\frac{1}{4}$ mile northeast of the bridge are fossiliferous softer and less massive beds. They include tan-gray marly beds, nodular limestone, and calcareous shale, with a few intercalations of massive limestone up to 3 feet in thickness.

NATIONAL MUSEUM COLLECTIONS

Collection 11340. Same locality as Collection 6 in the Pongo de Manseriche.

Collection 11341. Describe merely as having been obtained "above Contamana" ($74^{\circ} 52' E, 7^{\circ} 15' S$) in Loreto.

PART II

ECHINOIDEA, PELECYPODA AND GASTROPODA

by

EDWARD F. RICHARDS

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PART II

PHYLUM ECHINODERMA

CLASS ECHINOIDEA

FAMILY PYGASTERIDAE GREGORY

GENUS HOLECTYPUS DESOR

Holectypus planatus Römer var. *numismalis* Gabb

PLATE I, Figs. 1, 2, 3

Holectypus planatus Römer var. *numismalis*, Sommermeier, Neues Jahrb. für Min., B. B. 36, p. 394, pl. 15, figs. 1-3.

Test faintly pentagonal, moderately depressed, the apex forming a broad, obtuse angle in cross section; abactinal surface regular, sloping, straight near the apex, and becoming faintly convex near the margin; actinal surface slightly convex and moderately excavated near the margin and medial portion, becoming rapidly concave near the peristome; ambulacral areas narrow, straight, and flush with the remaining surface of the test; poriferous zones very narrow and far apart; pore pairs oblique; pores very small, round, and those of each pair closely spaced with reference to each other; alternate plates of the interambulacral areas of the dorsal surface bear one very small tubercle, with sunken areole, placed one third of the length of the plate from the adradial suture and three or four columns of smaller tubercles which do not persist to the apex; the intervening plates are not studded with tubercles; alternate plates of the ambulacral areas of the abactinal surface bear one very small tubercle situated very close to the adjacent poriferous zone, and the intermediate plates bear two smaller tubercles; the ambulacral and interambulacral areas of the surface bear regularly arranged, concentric rows of closely spaced tubercles with sunken areoles, which though small, are considerably larger than those of the dorsal surface, but become smaller and more widely and irregularly spaced as they approach the peristome; microscopic granules are present over the entire surface of the test; apical disk small, flush, central in position; genital plates distinctly perforated; peristome central in position, of medium size, clearly decagonal, with well-marked branchial incisions; periproct large pyriform, situated near the posterior edge of the test.

Dimensions: length, 37 millimeters; width, 35 millimeters; height, 15 millimeters.

The form represented in our collection is believed to be identical with the species described and figured by Sommermeier, as it agrees with the latter very closely in size and outline. The position, size and shape of the periprostome and periproct is identical in the two forms, as is also the size and arrangement of the tubercles of both the ambulacral and interambulacral areas of the actinal and abactinal surfaces. The type of the species, as designated by Sommermeier, is very inadequately described and figured by Gabb (24, p. 300, pl. 43, figs. 3, 3a, 3b) and the identity of the two forms seems somewhat questionable. *H. numismalis* Paulke (45, p. 261) included in the synonymy of Sommermeier, is not figured. From the description it is not possible to establish the identity of the latter species with our form. *H. cf. serialis* Paulke (45, p. 260, pl. 16, figs. 3, 3a) is believed to represent a different species, as it differs from our species by its somewhat larger size, and proportionally much larger peristome and periproct. According to Sommermeier, *H. planatus* Römer var. *numismalis* occurs in beds which range in age from Aptian to Vraconian. Our specimens occur with a pelecypod assemblage which strongly suggests that the age is Aptian.

Collection 317.

FAMILY ECHINONEIDAE WRIGHT

GENUS BOTRIOPTYGUS D'ORBIGNY

Botriopygus compressus Gabb

PLATE II, Figs. 1, 2, 3

Botriopygus compressus Gabb, Jour. Acad. Nat. Sci., Phila., 2nd ser., vol. 8, 1874-1881, p. 300, pl. 43, figs. 2, 2a.

Botriopygus compressus Berry, Johns Hopkins Univ. Studies in Geol., No. 2, 1922, p. 62, pls. 7, 12.

Gabb described this species as follows:

"Shell broadly elliptical, ends equal; upper surface very broadly convex; under, slightly concave; details of surface ornament unknown."

Berry adds the following details:

"Test compressed, slightly concave actinally, rather evenly rounded abactinally, slightly higher behind the middle. Ambital outline subcircular to shortly elliptical, slightly flattened in the interambulacra. Apical system and mouth slightly in front of the center. Periproct elliptical, on the actinal side of the posterior margin. Petals subequal, flush, not closing, becoming obsolete below the ambitus, the pores becoming distinct as the

margin is passed and the ambulacral plates here being very low and wide, each with a single pore pair; these pore pairs are biserial by the regular alternation of marginal and central positions. Ambulacral plates in the subequal petaloid areas low, smooth, the inner of the pores of each pair prominent, subcircular, the outer starting as pores in the apical region rapidly pass to long slit-like sulcations. Actinal surface of the interambulacra covered with numerous low tubercles. Abactinal surface not well preserved, apparently almost smooth. The two specimens from Huancavelica, shown in outline in the accompanying figures, have the following dimensions:

“Length 4.9 cm., 6.9 cm.

Width 4.1 cm., 6.2 cm.

Height 16.5 cm., 22.5 cm.”

Three specimens, too poorly preserved for complete description, are believed to belong to this species. In all essential characters they seem to be identical with the specimens described by Berry from Huancavelica. The most striking point of dissimilarity is to be noted in the position of the highest part of the test, which in two of our specimens is slightly in front of the middle. The third specimen of our collection agrees in this respect with Berry's description.

Dimensions of the three specimens in the collection:

Length, 4.5 centimeters; 4.1 centimeters; 3.9 centimeters.

Width, 4 centimeters; 3.2 centimeters; 3.2 centimeters.

Height, 1.5 centimeters; 1.5 centimeters; 1.5 centimeters.

In addition to the two occurrences of the genus listed above, Berry adds that “Lisson records undetermined species of *Botriopygus* from Ventanilla, Province of Yauli, and Luya, Province of Luya, in the Department of Lima, and considers them as well as Gabb's two species as of Aptian age.” The specimens in our collection come from a locality which contains a pelecypod assemblage which also strongly suggests an Aptian age (see introduction).

Collection 317.

FAMILY SPATANGIDAE WRIGHT

GENUS ENNALASTER D'ORBIGNY

Ennalaster peruanus Gabb

PLATE I, Figs. 4, 5, 6

Ennalaster peruanus Gabb, Jour. Acad. Nat. Sci. Phila., 2nd. ser., vol. 8, 1874-1881, p. 301, pl. 43, figs. 4-4c.

Enallaster peruanus Berry, Johns Hopkins Univ. Studies in Geol., No. 2, 1922, p. 63, pl. 6, figs. I-II. (Synonymy).

Test of medium size, oval, cordiform, longer than broad, rounded in front with a narrow and shallow anterior sulcus, narrowed and truncate behind, actinal surface having a low rounded ridge extending from the peristome to the posterior extremity, becoming slightly beveled at the posterior margin, and bounded laterally by shallow, broad sulci which extend from the postero-lateral margins to the peristome; abactinal surface moderately convex, highest posteriorly; anterior and lateral borders inflated; ambulacral areas subpetaloid, the anterior ambulacrum longer and wider than the others situated in a deep depression which grades into the anterior sulcus; poriferous zones of this petal moderately wide and far apart; pore pairs of each zone consisting of a round or oval pore toward the center of the ambulacrum and a transversely elongate pore toward the side of the ambulacrum, each alternate pore of the outside row is nearly twice as long as the preceding one; near the medial portion of the ambulacrum two of the longer pores may alternate with one short one; paired petals nearly flush, the antero-lateral pair nearly twice as long as the postero-lateral pair, with the petaloid parts divergent, flexuous and tending to close; poriferous zones of the anterior paired ambulacra very unequal, anterior pore pairs very small, round and oblique, with the pores of each pair close together; the posterior pore pairs are transversely elongate, the anterior pores situated in the middle of the furrow and of one half the length of the pores of the posterior row; poriferous zones of the posterior paired ambulacra subequal, and moderately wide; anterior pore pairs oblique, slightly smaller than the posterior pore pairs with the anterior pores of each pore pair transversely elongate, and the posterior pores oval; posterior pore pairs oblique, having the anterior pore of each pore pair oval and the posterior pores transversely elongate; surface of the test covered with small tubercles which are sparsely scattered, and become slightly smaller and more closely spaced near the ambitus; below, a triangular area between the mouth and the posterior extremity, and bordered by broad smooth

strips, is closely studded with tubercles; between the tubercles there is a microscopic granulation; apical disk small, nearly flush with the surrounding surface of the test, situated slightly posterior to the center of the abactinal surface; the genital plates are distinctly perforated; posterior and anterior genital pores equally distant from each other; peristome sub-circular, transverse, with prominent-posterior labrum, situated at posterior extremity of the anterior third; periproct subcircular greatest diameter vertical of about the same size as the peristome, situated just below the upper extremity of the posterior truncation.

Dimensions: length, 29 millimeters; width, 27.5 millimeters; height, 16 millimeters.

This species, of which the type was described by Gabb from material sent to him by Raimondi from the vicinity of Ollen, 2 leagues from Cajamarca in the Department of Cajamarca, Peru, is widely distributed throughout the Cretaceous of Peru, and has been reported from beds to which ages ranging from Aptian to Cenomanian have been assigned. It is represented in the collection by abundant material, and is believed to be identical with the form described from Huancavelica by Berry, who gives a full discussion of the synonymy and affinities of the species. Our specimens occur in association with a pelecypod assemblage which strongly suggests that the age is Aptian.

Collection 317.

Ennalaster roscheni n. sp.

PLATE II, Figs. 4, 5, 6

Test large, ovate-pentagonal, longer than broad, rounded in front and with a deep anterior sulcus, narrowed and truncate behind; actinal surface moderately convex, slightly arched near posterior extremity; abactinal surface moderately convex, highest posteriorly; anterior and lateral borders inflated; ambulacral areas petaloid; anterior ambulacrum longer and wider than the anterior paired ambulacra, situated in a broad, deep, depression which grades into the anterior sulcus; poriferous zones of this petal broad and far apart; pore pairs unequal, with two successive equal pairs which have a transverse, oval pore toward the center of the ambulacrum and a transversely elongate pore near the side alternating with a pair of transverse, oval pores which are more closely spaced with reference to each other; this arrangement is modified near the apical extremity of the ambulacrum where the pore pairs become equal and consist of oval pores which finally become circular near the apical disk; paired petals very

slightly depressed, the anterior lateral pair nearly twice the length of the posterior lateral pair, having the petaloid parts divergent, flexuous and closed; poriferous zones of the paired ambulacra very unequal; the anterior pore pairs very small, round, slightly oblique, and with the pores of each pair close together; the pores of the posterior pore pairs are transversely elongate, with the anterior pore of each pair situated in the middle of the ambulacral furrow and of one half the length of the pores of the posterior row, except near the extremities where the posterior pores become shortened; surface of the test covered with small, sparsely scattered tubercles; below, a subtriangular area between the mouth and the posterior extremity is closely studded with tubercles which become smaller and more closely spaced about a slightly produced apical portion near the posterior median portion of the area; a minute granulation is present between the tubercles; apical disk small, slightly sunken, situated slightly posterior to the center of the dorsal surface; posterior genital pores slightly more widely separated than the anterior pair; peristome subcircular, with posterior labrum, situated at the posterior extremity of the anterior third; periproct situated just below the upper extremity of the posterior truncation.

Dimensions: length, 47 millimeters; width, 44 millimeters; height, 23 millimeters.

This form is very closely related to *Enmalaster peruanus* Gabb, but is considered to be a new species. It is larger than any specimen of *E. peruanus* thus far recorded, and differs further from the latter in the following details: it has a different arrangement of the pore pairs of the anterior ambulacrum, has a more angular and less cordiform outline, and has a deeper anterior sulcus. It occurs with a faunal assemblage which suggests that the age is Aptian.

Type material: Holotype.

Collection 317.

FAMILY SPATANGIDAE WRIGHT

GENUS HEMIASTER DESOR

Hemiaster fourneli var. *obliquus* Brüggén

PLATE I, Figs. 7, 8, 9

Hemiaster Fourneli nov. var. *obliquus* Brüggén, Neues Jahrb für Min, B. B. XXX, 1910, p. 772, pl. 27, fig. 2.

Test of medium size, ovate-pentagonal, rounded in front with a deep anterior sulcus, narrowed and obliquely truncate behind, actinal surface moderately convex, abactinal surface highly convex, arched into a high,

sharp ridge in the posterior interambulacral area, sloping downward in front; ambulacral areas petaloid, with straight petals situated in deep depressions of the surface, the posterolateral pair three fifths the length of the anterolateral pair, poriferous zones of the paired petals wide, pores transversely elongate, with the rows of pores far apart and equispaced; anterior petal longer but very slightly narrower than the others, situated in a fairly deep depression which grades into a deep and narrow anterior sulcus, which persists ventrally to the peristome; poriferous zones of this petal very narrow and far apart; pores small, oval, and the pore-pairs are slightly oblique; surface closely covered with small tubercles which increase in size toward the peristome, between the tubercles there is a microscopic granulation; on the ventral side there is an irregularly triangular area with the apex directed anteriorly and extending to the peristome, bordered laterally by fairly broad, smooth strips; peripetalous fasciole narrow and indistinct anteriorly, curving regularly around the ends of the petaloid areas, moderately bent upward between the anterior and posterior paired ambulacra; apical disk small, sunken, and situated slightly anterior to the center of the abactinal surface, the four genital plates distinctly perforated, with the posterior genital pores slightly more distant than the anterior pair; peristome subreniform, transverse, with prominent posterior labrum, situated near the anterior margin; periproct elliptical, greatest diameter vertical, situated just below the upper extremity of the posterior truncated area.

Dimensions: length, 32 millimeters; width, 29 millimeters; height, 19.5 millimeters.

The genus *Hemiaster* is represented in our collection by a large number of specimens which are for the most part too poorly preserved for specific determination. One specimen is in a nearly perfect state of preservation, however, and is believed to represent the species *H. fourneli* var. *obliquus* Brüggen. Both forms have the obliquely truncated posterior margin; narrow, elliptical periproct situated near the upper extremity of the posterior truncation; posterior interambulacrum arched into a high, sharp ridge; and the apical disk situated slightly anterior to the center of the abactinal surface. The most striking difference between the two forms is in the size. For example, Brüggen gives the following dimensions:

Length 2.3 cm, width 2.1 cm, height 2.3 cm.

H. fourneli was described by Cotteau (17, fasc. 7, p. 58, pl. 2) from the Senonian of Algiers.

Brüggen distinguishes four varieties of the species and gives a detailed discussion of their affinities.

Neumann (39, p. 99) reports the occurrence of *H. fourneli* from La Quinua, Central Peru, from beds believed to be of Santonian age. His description is not accompanied by figures, and the identity of his form with ours cannot be verified. Our specimens occur in beds which contain *Ostrea nicaisei* Coquand, indicating that the age is probably Emscherian.

Collections 307, 44, 46, 50, 51.

PHYLUM MOLLUSCA

CLASS PELECYPODA

FAMILY NUCULIDAE ADAMS

GENUS NUCULA LAMARCK

Nucula turgida n. sp.

PLATE I, Figs. 10, 11

Cast convex highly inflated throughout; inequilateral, equivalve, attaining a large size for the genus; elongate, nearly straight; anterior margin rounded, produced; ventral margin broadly convex throughout, curving upward more rapidly in front than behind; posterior margin sharply rounded; posterior cardinal margin short, slightly concave; beaks small, pointed, proximate, opisthogyrate, situated one third of the length of the cast from the posterior extremity; escutcheon suggested by a deeply excavated, concave, smooth area with an elliptical outline, starting just behind the beaks and extending to the end of the posterior cardinal margin; posterior adductor muscle impressions strongly defined, subcircular in outline, and situated near the posterior margin at the distal extremity of the posterior hinge line; a low, narrow, evenly rounded ridge originates a short distance in front of beaks, just above the anterior cardinal margin near the medial portion of the shell; it is bounded on each side by a shallow, U-shaped furrow of about equal width as the rib, and extends in an obliquely anterior direction, becoming entirely obsolete before it reaches the lateral portion of the valve.

Dimensions: length, 35 millimeters; height, 20 millimeters; diameter (both valves) 16 millimeters.

Type material: Holotype.

Collection 317.

Nucula pongensis n. sp.

PLATE I, Figs. 12, 13

Shell of medium size, moderately convex, inequilateral, equivalve; elongate, subelliptical in outline; anterior cardinal margin oblique, gently arched; anterior margin evenly rounded, strongly produced; ventral margin broadly convex throughout; posterior margin very short and sharply rounded; posterior cardinal margin half the length of the anterior cardinal margin, faintly arched; anterior, ventral, and posterior slopes moderately flattened; beaks small, pointed, proximate, incurved, situated one third of the length of the shell from the posterior extremity; ornamentation consists of numerous, closely spaced and well-defined growth lines crossed by closely spaced, faint, radial lines.

Dimensions: length, 29 millimeters; height, 17 millimeters; diameter (both valves) 10.5 millimeters.

Remarks: This species differs from *Nucula turgida* in the following details: it is considerably smaller, and the anterior, ventral and posterior slopes are very gradual and only moderately flattened, while the latter species is highly inflate throughout and has abrupt, highly curved slopes, especially near the margins. The internal characters of the species are not known.

Type material: Holotype.

Collection 6.

FAMILY PARALLELODONTIDAE DALL

GENUS CUCULLAEA LAMARCK

Cucullaea reesideana n. sp.

PLATE II, Figs. 7, 8, 9

Shell of medium size, thick, heavy, evenly convex, equivalve, inequilateral; subcircular in outline; anterior margin rounded; ventral margin broadly arcuate and approximately horizontal; posteroventral margin slightly produced; postero-dorsal margin obliquely truncate; beaks small, blunt, inconspicuous, feebly prosogyrate, distant, slightly inflated below their summits, inconspicuous, small, placed back from the anterior margin a distance of about one third of the total length; external surface bears numerous low, concentric folds which are close set but irregular in size and arrangement, suggesting an exaggerated incremental sculpture with a few pronounced resting stages which are most prominent near the ven-

tral margin; fine, closely spaced growth lines are superimposed upon all the other sculpture and are present on whole of shell except the umbonal area, which is smooth; ligament amphidetic, lodged in an obtusely triangular area between the beaks and the teeth; ligament area marked by 8 or 9 fine, concentric sulci which are regularly curved and subparallel to the upper margin of the ligament area; hinge line straight, about five eighths of total length; ventral margin of the hinge plate gently arcuate; central teeth short, about twelve in number, straight, becoming slightly longer and more oblique distally; anterior and posterior lateral teeth straight, parallel to internal margin of hinge plate; posterior teeth slightly longer than anterior.

Dimensions: length, 50 millimeters; height, 47 millimeters; diameter (both valves) 25 millimeters.

Type material: Cotypes.

Collection 38.

Cucullaea andersoni n. sp.

PLATE I, Figs. 14, 15

Shell of medium size, moderately thick, evenly and moderately inflated, inequilateral; outline subovate, regular; anterior margin short, rounded, merging with broad curve into the ventral margin; ventral margin broadly arched, oblique; posterior margin short, sharply rounded, strongly produced; postero-dorsal margin broadly arched, long, oblique; beak low, pointed, inconspicuous, feebly prosogyrate, distant, anterior in position; external surface bears numerous low, concentric ridges or folds which are close set and irregular in size and arrangement, with a few pronounced resting stages developed near the ventral margin; ligament amphidetic, small, lodged in short, narrow, semielliptical area between the beak and the hinge plate; hinge line straight, about one third total length; hinge plate narrow, broadly arched ventrally; central teeth about ten in number, close-set, straight, short, directly under the beak, and becoming slightly longer distally; anterior lateral teeth slightly curved, oblique, fairly long, two in number; posterior lateral teeth, nearly straight, oblique, nearly twice as long as anterior laterals, three in number.

Dimensions: left valve greatest length measured obliquely from anterior to posterior margin, 45 millimeters; greatest height, measured at right angles to above dimension, 33 millimeters; diameter, 16 millimeters.

This species has been described from one left valve. The ornamentation on the lateral and dorsal areas has been obliterated, and the internal characters are unknown.

It is distinguished from *Cucullaea reesideana* by its smaller size, the greatly produced posterior margin and more ovate outline, the remarkably small ligament pit, and the exaggerated length of the posterior cardinal teeth.

Type material: Holotype.

Collection 35.

Cucullaea gabrielis Leymerie ?

PLATE III, Figs. 3, 4

Shell thick, heavy, highly inflated, moderately large, equi-valved; anterior margin short, slightly produced, and verging into basal margin with a broad, gentle curve; posterior margin obliquely elongated, keeled; external surface ornamented only by fine lines of accretion showing frequent but irregular resting stages which are more conspicuous towards the ventral margin; umbones very prominent, widely distant, orthogyrate, incurved, and slightly superincumbent above cardinal area; cardinal area flatly oval in outline, elongated, surface concave, covered by 12 straight, narrow, equispaced ligament grooves which meet in a broad obtuse angle under the umbones, and reach the hinge line at a sharp acute angle; hinge line straight, two thirds the total length of shell.

Dimensions: Length, 95 millimeters; width, 68 millimeters; height, incomplete.

One imperfect shell has been tentatively referred to this species. In size, ornamentation, and general proportions it corresponds very closely to the European species *Cucullaea gabrielis* Leymerie (33, pl. 7, fig. 5) and *Arca dilatata* Coquand (16, p. 139, pl. 22, figs. 1, 2) from the Aptian of Spain. It cannot be stated with certainty, however, whether or not the South American species *Cucullaea dilatata* d'Orbigny (42b, p. 54, pl. 5, figs. 5-7) (42c, p. 89, pl. 20, figs. 5-7) is identical with either the European species or our own specimen, as the references are not available. Gerhardt (25, p. 179) does not figure or describe the casts from Colombia which he has called *Arca gabrielis* (Leymerie). The presence of *Cucullaea gabrielis* Leymerie has been reported by Richard Stappenbeck (64, p. 320) in Northern Peru, but no description or figure is given. In both the latter instances *Cucullaea gabrielis* occurs in beds which contain an Aptian faunal assemblage.

Collection 317.

FAMILY ARCIDAE DALL

GENUS ARCA LINNÉ

Arca knechteli n. sp.

PLATE IV, Figs. 5, 6

Cast of medium size, inflated in umbonal region, equivalve, strongly inequilateral; outline roughly trapezoidal; cardinal margin broadly arched, nearly two thirds total length; anterior margin short, vertically truncate, forming a rounded right angle with the ventral margin; ventral margin horizontal, nearly straight in front, and curved upward posteriorly, meeting the postero-dorsal margin in a produced, rounded obtuse angle; postero-dorsal margin obliquely truncate, forming a distinct obtuse angle with the cardinal margin; beaks moderately high, broad, convex, prosogyrate, slightly distant, anterior in position, with a prominent rounded angle between lateral and posterior slopes extending from the posterior portion of the beaks to the lower extremity of the postero-dorsal margin; ornamentation consists of numerous close-set, rounded, faint radial lines and grooves appearing on the lateral slope near the ventral margin; anterior adductor scar poorly defined, small, high up under the anterior extremity of the hinge line; posterior adductor subtrigonal in outline, situated high up under posterior extremity of the hinge line, and buttressed by a prominent myophore expressed in the cast by a radial groove which is deep near the postero-dorsal margin and becomes obsolete before reaching the beak; pallial line simple, situated near margins.

Dimensions: length, 41 millimeters; height, 26 millimeters; diameter (both valves) 27 millimeters.

Type material: Holotype.

Collection 6.

Arca megumbona n. sp.

PLATE IV, Figs. 10, 11

Cast of large size, highly inflated, strongly inequilateral; outline roughly subovate; cardinal margin broadly arched, about three fourths total length; anterior margin slightly produced beyond beaks, evenly rounded, and merging with a broad and gentle curve with ventral margin; ventral margin broadly and evenly arcuate; posterior margin rounded, strongly produced; beaks very prominent, distant, prosogyrate, their summits broadly arched, blunt, raised high above the hinge line, anterior in position,

with a very conspicuous, rounded angle between lateral and posterior slopes extending obliquely from the posterior portion of the beak to the posterior margin; a similar, but inconspicuous, angle is present between the lateral and anterior slopes extending vertically from the anterior extremity of the beak to the anterior extremity of the ventral margin; the dorso-lateral angle is bounded on the dorsal slope by a deep, broad furrow, or myophore impression, which originates near the postero-dorsal margin and extends, with decreasing size, nearly to the apex of the beaks; a similar, but shallower, furrow bounds the antero-lateral angle; surface marked by numerous radial lines and grooves near ventral and posterior margins; hinge plate very gently arcuate ventrally; hinge teeth of a single series, short and straight beneath beaks, becoming oblique distally.

Dimensions: left valve; length, 57 millimeters; height, cardinal to ventral margins measured at right angles to above dimension, 38 millimeters; diameter, 26 millimeters.

This species is represented in the collection by one internal cast. It is distinguished from *Arca knechteli* by its larger size, greater degree of convexity, coarser ornamentation, and subovate outline.

Type material: Holotype.

Collection 6.

FAMILY PINNIDAE MEEK

GENUS PINNA LINNÉ

Pinna decussata Goldfuss ?

PLATE IV, Fig. 4

Shell of medium size, thin, elongate, depressed; outline triangular, cross section rhombic; dorsal margin straight, ventral margin very slightly curved, forming a sharp acute angle with the dorsal margin; ornamentation consists of about twelve ribs, of which five or six, which are dorsal in position, are moderately strong, rounded, and separated by broad, flat-bottomed interspaces; along the ventral slope the ribs decrease in size and become obsolete near the ventral margin; low, rounded concentric lines, suggesting resting stages, occur at irregular intervals and produce small, inconspicuous node-like swellings where they cross the radial ridges.

One fragmentary shell has been doubtfully referred to this species. The type came from the Quadersandstone of Haltern (Westphalia) and Schandau (Saxony) (25a, p. 166, pl. 118, fig. 4). The species is widespread throughout Central Europe and England (84, v. 2, pt. 3, p. 99, pl. 13, figs.

4-6; pl. 14, fig. 1), where it ranges in age from Turonian to upper Senonian. Brüggen (8, p. 753) described one specimen which he identified as this species from Pastos de Lachoj, near Hullauca, Department of Huanuco (Northern Peru), from beds believed to be of Emscherian age. Berry (3, p. 68, pl. 8, fig. 1) has noted the occurrence of a *Pinna* at Huancavelica which he doubtfully refers to this species. The identification of the South American species as *Pinna decussata* must be considered tentative for the present, as in the instances where it has thus far been noted the state of preservation has been too poor for adequate characterization as a basis for comparison.

Collection 307.

FAMILY PERNIDAE ZITTEL

GENUS INOCERAMUS SOWERBY

Inoceramus concentricus Parkinson

Inoceramus concentricus Woods, Mon. Cret. Lamell. England, v. II, pt. III, 1906, p. 265, pl. 45, fig. 11; pl. 46, figs. 1-10; pl. 47, figs. 1, 2, (Synonymy).

? *Inoceramus concentricus* Reeside, Bull. Amer. Assoc. Petrol. Geol., v. 11, 1927, No. 12, pl. 12, figs. 12, 13; pl. 13, fig. 12.

Woods characterizes this species as follows:

"Shell more or less ovate, much higher than long, very inequilateral and inequivalve. Anterior part of valves flattened or concave, often more or less nearly perpendicular to the plane between the valves. Posterior part of the valves somewhat expanded and less convex than the part below the umbones. Postero-dorsal part forming a small wing. Left valve very convex, with a high, narrow, pointed, terminal umbo which is considerably incurved and bends forwards. Right valve considerably less convex than the left valve, with a small, terminal umbo curved forwards but only slightly inwards. Hinge-line less than half the height of the shell.

"When the shell is perfect the surface is nearly smooth except for numerous regular growth-rings. When the outer layer of the shell is wanting concentric undulations or ribs having an unsymmetrical curvature are seen, and are separated by concave furrows."

Dimensions of an external cast showing both valves: greatest length, obliquely from the beak to the postero-ventral margin 43 millimeters; height, at right angles to the last dimension 30 millimeters; diameter (both valves), 23 millimeters.

According to Woods, "the type, which came from the Gault of Folkstone, cannot be found. The specimens from the same locality figured by

Sowerby and by Mantell, and the type of *I. gryphaeoides* from the Upper Greensand near Lyme Regis, are in the British Museum."

The seven specimens of this species represented in the collection from the Pongo agree with the description given by Woods in all details. They are not characterised by the variability in size and proportion which is shown by the figured specimens of Woods, but this may be due to lack of material, and may not be an inherent characteristic of the South American representatives of the species. The shell substance is partially preserved in most of the specimens, and the casts are in most cases well preserved. The species is widespread in the Albion of England and Central Europe. It is identified with some uncertainty as the form to which Reeside (54, pl. 12, figs. 12, 13; pl. 13, figs. 12) applied the same name from the Albion of Ecuador.

Collection 6.

Inoceramus sp.

PLATE IV, Fig. 3

Shell thin, small, inequilateral, inequivalve; ornamentation consists of fairly regular concentric undulations which have an unsymmetrical curvature; fine concentric lines extend over the entire surface.

A single fragmentary specimen is represented in the collection. Its affinities cannot be determined, and it is insufficient for the characterization of a new species.

Collection 307.

FAMILY OSTREIDAE LAMARCK

GENUS EXOGYRA SAY

Exogyra n. sp. aff. *E. africana* Coquand

PLATE IV, Figs. 1, 2

Shell small, moderately thick, nacreous, inequilateral, inequivalve; outline subovate; left valve convex, highly inflated; dorsal and ventral margins broadly arched, merging with even curves into the anterior and posterior margins which are more sharply curved and shorter; posterior margin longer and more broadly curved than the anterior margin; anterior and lateral slopes broadly convex, attaining maximum expansion near anterior and ventral margins and merging without change into the portion below the beak; posterior slope obliquely truncate, nearly flat;

umbonal portion of shell flatly coiled, with narrow, pointed terminal beak which is strongly incurved and opisthogyrate; external surface smooth, not ornamented by any definite pattern; when outer layer of shell is lost, faint, inconspicuous, narrow, radial lines appear, separated by very shallow subequal sulci, and the entire surface bears irregular, thin incremental lamellae which impart to the shell a scabrous appearance.

Dimensions, left valve: greatest length, obliquely from the beak to the postero-ventral margin, 31 millimeters; greatest height, at right angles to the above dimension, 20 millimeters; diameter, 21 millimeters.

This species closely resembles *Exogyra africana* Coquand, but differs from the latter in the following details: it is more flatly coiled, has a much more regularly ovate outline, is more broadly expanded along the anterior ventral slope, and the flexure between the lateral and posterior slope is not as abrupt.

Type material: Holotype.

Collection 6.

Exogyra sp.

Shell moderately thick, subcircular to subovate in outline; margins regularly rounded; left valve much larger than the right valve, arched; apical spirally coiled within the margin, having a prominent umbonal ridge curving from the beak to the posterior margin, near which it becomes lower and more broadly rounded; behind the beak the valve is slightly concave; in front it is regularly convex and very steep toward the anterior portion, attaining a gentler slope posteriorly; numerous fairly large, irregular, rounded straight ribs are present on the anterior and ventral slopes, descending obliquely from the umbonal ridge toward the posterior margin; right valve roughly disk-shaped, flatly spiral, with a broadly convex umbonal ridge extending to the posterior margin in a curve corresponding to the spiral twist of the shell; a shallow, broadly U-shaped groove extends between the umbonal ridge and the anterior and ventral margins, becoming obsolete along the posterior margin; behind the ridge the valve is broadly concave.

Dimensions: length, 95 millimeters; height, 6 millimeters; diameter, both valves, 46 millimeters.

Three poorly preserved specimens were available for the partial description of this species. A complete description cannot be given because the exterior ornamentation is almost entirely absent, and the internal characters cannot be ascertained from the material at hand.

Collections 316, 317.

Exogyra flabellata Goldfuss (?)

PLATE IV, Fig. 7

Shell of medium size, moderately thick; subovate in outline; margins irregular, corrugated; left valve convex, arched, with a rounded ridge curving from the neck to the postero-dorsal margin where it becomes less prominent; behind the beak the valve is slightly concave, with postero-dorsal part flattened behind the keel; in front it is regularly convex; the beak is broadly spiral, incurved and inconspicuous, situated in anterior third of the shell; scar of attachment small, inconspicuous; from the beak a number of fairly large well-rounded and curved ribs extend to the margin, following in the dorsal portion the general direction of the ridge, while in the anterior and ventral parts they descend obliquely toward the posterior margin; some of the ribs bifurcate occasionally, especially along the ridge, in the anterior and ventral parts the bifurcations are very rare, and the ribs tend to converge near the ridge and increase in size from keel to margins; small tubercles of irregular shape and size, without any definite pattern, occur on the ribs, and are found with most frequency near the keel; the thickness and size of the ribs vary considerably, as does that of the interspaces; ribs and interspaces are covered with well-marked growth-lines.

Dimensions: length, 37 millimeters; width, 16 millimeters; height, 32 millimeters.

This species is represented in the collection by only one left valve which, though imperfect, shows the essential exterior characters of the shell. Our specimen is somewhat doubtfully referred to this variable, wide-spread, and probably composite species. It bears a close resemblance to one of the specimens of *Exogyra flabellata* Goldfuss figured by Pervinquière (48, p. 189, pl. 13, fig. 68), having approximately the same number of ribs, outline, and degree of inflation. It differs from *Exogyra texana* Roemer (55, p. 69, pl. 10, figs. 1a-e) by its smaller size, more rounded lateral ridge, and fewer ribs. It differs from typical specimens of the latter species also by the fact that in the latter the ribs radiate from the beak, which is strongly incurved, and throughout the anterior half extend obliquely over the lateral ridge to the anterior and ventral margins, while in *Exogyra flabellata* the ribs tend to follow the lateral ridge, or originate at this point by bifurcation, altho in extreme cases, as has been pointed out by Böse (6, p. 112; pl. 20, figs. 14-16; pl. 21, figs. 1-11; pl. 22, figs. 1-9) *Exogyra texana* very closely approaches the appearance of *Exogyra*

flabellata. It seems to us that altho both species do not afford well marked specific characters, our specimen is best referred to the African species.

Collection 310.

GENUS OSTREA LINNÉ

Ostrea nicaisei H. Coquand

PLATE V, Fig. 1; PLATE VI, Figs. 1, 2

- Ostrea elegans* Bayle, Fournel, Rich. Min. Alg., 1849, pl. 17, figs. 19-23.
Ostrea nicaisei, Coquand, Geol. et Pal. Const., 1862, p. 232, pl. 22, figs. 5, 6, 7.
Ostrea nicaisei, Harduin, Bull. Soc. géol. France, ser. 2, v. 25, 1868, p. 339.
Ostrea nicaisei, Brossard, Mem. Soc. géol. France, ser. 2, v. 8, 1867, p. 241.
Ostrea nicaisei, Coquand, Mon. Ostrea, 1869, p. 34, pl. 6.
Ostrea nicaisei, Nicaise, Catal. anim. foss. prov. Alger, 1870, p. 78.
Ostrea callacta Conrad, Proc. Acad. Nat. Sc. Phil., 1875, pp. 139, 122, fig. 1.
Ostrea callacta Conrad, Gabb, Jour. Acad. Nat. Sc. Phil., v. 8, 2nd ser., 1877, p. 296, pl. 42, fig. 7.
Ostrea nicaisei, Cotteau, Peron et Gautier, Descr. Echin. fos. Algerie, Et. senonien, 1881, p. 18.
Ostrea nicaisei, Ficheur, Bull. Soc. géol. France, ser. 3, v. 17, 1889, p. 256.
Ostrea nicaisei (Thomas & Peron) Peron, Description des Moll. Foss. de la Tunisie, 1893, p. 178.
Ostrea nicaisei, Paulke, Ueber die Kreideformation in Sudamerica. Neues Jahrb. B. B. 17, 1903, p. 261.
Ostrea cf. *nicaisei*, Annales de Paleontologie, 1906, v. 1. Boule et Thevenin, Fossiles de la Cote Orientale de Madagascar, p. 7, pl. 1, fig. 6.
Ostrea nicaisei, Brüggén, Neues Jahrb. B. B. 30, 1906, p. 741, pl. 25, fig. 1.
? *Ostrea Alectryonia* cfr. *nicaisei*, Böse, Ins. Geol. Mex., Bull. No. 24, 1906, p. 47, pl. 2, figs. 3, 4.
Ostrea nicaisei, Luthy, Beitrag zur Geol. u. Pal. v. Peru. Mem. Soc. Pal. Suisse, v. 43, 1918, p. 30, pl. 2, figs. 1-5.

Shell large, massive, approximately equivalved and equilateral; some individuals quite flat, others strongly inflated; free valve slightly more inflated than the attached valve; outline variable, usually circular especially in specimens not fully mature, but may also be oval or triangular and somewhat higher than long; strongly plicated, each valve having five to eight elevated and rounded folds which originate near the beaks and radiate with increasing size towards the margins; median folds on the two valves largest, becoming successively smaller and shorter dorsally, and alternating on the two valves so that the folds on the upper valve correspond to the interspaces on the lower; growth lines numerous, rough, and irregularly spaced; intermediate growth lines at intervals are enlarged to form scabrous lamellae; beaks central, small, broadly convex on the upper and flat or

slightly concave on the lower valve, which shows, as a rule, attachment scar; margins flexuose; area broad, flat; ligament pit broad, shallow; muscle scar large, ovate.

Dimensions: length, 11 centimeters; width, 9 centimeters; height, 3.5 centimeters.

Peron summarizes this species as follows (translated):

"From the point of view of morphology, *Ostrea nicaisei* is very constant and always easily recognizable. It presents rather wide variations, but of a nature so as not to modify essentially its physiognomy. It is primarily in the number and amplitude of the radial folds, in the spacing of the large, concentric lamellae, and in the degree of convexity of the upper valve that these variations are mainly manifested."

The occurrence of this species has thus far been reported only from the Campanian of northern Africa (Algiers and Tunis), and from the Emscherian (Santonian-Campanian) of Peru, where it has a wide distribution (see synonymy). Böse has described and figured some fragments which he doubtfully refers to this species from beds of supposed lower Senonian age of Cárdenas, San Luis Potosi, Mexico.

Collections 46, 307.

FAMILY TRIGONIIDAE LAMARCK

GENUS TRIGONIA BRUGUIÈRE

Trigonia hondaana Lea

PLATE VII, Fig. 8

Trigonia hondaana, Lea, Trans. Am. Phil. Soc. New Ser., v. 7, 1841, p. 256, pl. 9, fig. 9.

Trigonia boussingaultii, d'Orbigny, Fossiles de Colombia, 1842, p. 50, pl. 4, figs. 1-3.

Trigonia hondaana, d'Orbigny. Prod., t. 2, 1850, p. 106.

Trigonia hondaana, H. Coquand. Mon. de l'étage Aptien de l'Espagne, 1865, p. 136, pl. 24, figs. 1, 2.

Trigonia hondaana, Gerhardt. Neues Jahrb. für Min., B. B. 11, 1897, p. 183, pl. 5, fig. 6.

Trigonia hondaana, Choffat. Serv. géol. du Portugal, v. 6, 1904, p. 48.

Trigonia hondaana, Sommermeier, Neues Jahrb. für Min., B. B. 36, 1913, p. 381.

Lea describes this species as follows:¹

"Shell ovately triangular, inflated, with many ribs; ribs transverse, furnished with tubercles; posterior slope elevated, with numerous tubercles."

¹ Lea described this species from material contained in a miscellaneous collection of fossils sent to him by a friend, Dr. Gibbon, from New Granada.

Shell large and fairly thick; junction of anterior dorsal and ventral margins forms a broad, obtuse angle; beaks small, incurved, and inconspicuous; the first 5 or 6 ribs are small, sharp-crested and roundly curved from the keel to the anterior margin; succeeding ribs widely spaced, nearly perpendicular, only slightly curved forward near ventral margin, and studded with tubercles; area very broad and ornamented by 6 to 8 straight, procumbent, asymmetrical ribs which are succeeded posteriorly by a cancellated pattern of fairly close-set tubercles.

This species is represented in the collection by a single incomplete specimen which has been considerably crushed and of which only the anterior portion has been retained. The writer has examined several nearly perfect specimens of *Trigonia hondaana* from Colombia and feels that this specimen can be identified with certainty.

Trigonia hondaana has been reported from beds known to be of Aptian age from Spain, Portugal, Colombia and Northern Peru.

Collection 117.

Trigonia subcrenulata d'Orbigny

PLATE VII, Fig. 4

Trigonia subcrenulata, d'Orbigny. Coquil. et échin. foss. de Colombia, 1842, p. 52, pl. 4, figs. 7-9.

Trigonia crenulata, Römer. Kreidebild. v. Texas, 1852, p. 51, pl. vii, fig. 6.

Trigonia subcrenulata, Gerhard. Neues Jahrb. für Min., B. B. 11, 1897, p. 184.

Trigonia crenulata Lamarck var. *peruana*, Paulke. Neues Jahrb. für Min., B. B. 17, 1903, p. 272, pl. 15, fig. 9.

Trigonia subcrenulata, Sommermeier. Neues Jahrb. für Min., B. B. 36, 1913, p. 382.

One left valve, fragmentary and poorly preserved, is doubtfully referred to this species. The shell is highly inflated anteriorly, crescentic, and posteriorly elongate and somewhat flattened; ornamented by small perpendicular, widely separated crenulated rows of costae. In shape, as well as the general features of its ornamentation, it is closely allied to *Trigonia crenulata* Lam. var. *peruana* figured by Paulke, altho not identical. Our shell is higher and proportionally shorter and not as highly inflated anteriorly. The ribs are straighter near the keel, while those of Paulke's figure are slightly curved backwards, giving the rib a gently sigmoid outline.

Dimensions (left valve): length, 50 millimeters; width, 19 millimeters; height, 40 millimeters.

The writer has examined several specimens of *T. subcrenulata* from Colombia and has noticed considerable variation both in form and ornamentation. The identification of our specimen with this species is based upon

the above observation, and particularly upon the following observations of Sommermeier :

"Associated with *Trigonia hondaana* there is a considerable number of specimens (24 shells and 7 casts) which, considering their great variability, may be united with the similar species, *Trigonia subcrenulata*, from the neighboring district in Colombia. In these specimens there has been observed a varying development of form and ribbing which permit the above-mentioned types (see synonymy) to be included as synonyms, and especially, the identity of Paulke's form from Peru cannot be doubted. Also, the similarity with the upper Cretaceous *Trigonia crenulata* Lam. (42a, p. 151, pl. 295) is so great in the case of some examples that differences can hardly be distinguished. Some of the compressed forms which have been examined are predominantly of this and Paulke's variety. Others resemble more closely the species "subcrenulata," altho sharp boundaries cannot be drawn between the various forms. The development of the anterior extremity is likewise variable, in that it varies in the degree of truncation, and the curvature may be sharp or gentle. Variations also occur in the course of the ribs, their degree of separation, size, and number, but in such an indefinite manner that no difference of specific value can be distinguished . . ."

Collection 317.

Trigonia mathewsi n. sp.

PLATE VII, Figs. 9, 10

Shell large, fairly thick, highly inflated below the beaks and slightly compressed toward the postero-ventral margin; anterior, ventral and postero-ventral margins merge into each other with an uninterrupted, broad, gentle curve giving to the shell an evenly rounded and almost circular outline; postero-dorsal margin short, slightly protracted, gently curved and oblique, forming an obtuse angle with the dorsal margin which is straight and slopes obliquely downwards; beaks moderately elevated, slightly incurved, situated in anterior third of shell; the surface of the valve is divided into two portions by a curved keel which passes backwards from just behind the beak to the extremity of the postero-dorsal margin; the lower portion of the valve constitutes much the greater part and is ornamented by about 17 ribs which are sharp-crested near the beaks and inequilateral, inclined with the short side facing the beaks; the first 7 or 8 ribs are small, roundly curved forwards, but are followed by ribs which become larger toward the central margin, separated by successively broad-

er interspaces which are formed by the elongation of the underside of the ribs; after the rounded ribs, which do not show any angle, there are 3 or 4 which show, a little below the keel, a sudden flexure at first slight but becoming a sharp angle which is at first obtuse but soon becomes a right angle, on one side of which the ribs extend vertically to the keel, and on the other side pass horizontally toward the anterior margin near which they become obscure and slightly curved upward; posteally the lower horizontal ribs form a sudden flexure downwards and then turn upwards and meet the keel at an acute angle; the last few ribs have their postea portions slightly disunited where they form the angle; growth-lines are visible on all of the shell, but become most conspicuous near the lower border, giving a faintly corrugated appearance to the interspaces between the vertical ribs; upper portion of shell is broad, flattened, and transversely plicated with numerous, very closely arranged, plain, sharpcrested costellae, which show the same type of unsymmetrical development characteristic of the lateral ribs; the costellae originate at the keel, are almost equally divided by a slight groove which runs subparallel to the keel, and finally disappear at the escutcheon; escutcheon is long, fairly broad, and concave.

Dimensions: length, 55 millimeters; height, 42 millimeters; diameter (both valves) 35.5 millimeters.

This species is represented in the collection by about twenty specimens, all of which are too imperfect, individually, to permit the selection of a holotype. It is distinctly different from any species of *Trigonia* known to the author, either from South America or Europe, and is well characterized by the strong, inequilateral, angulated ribs.

Type material: Cotypes.

Collections 117, 205.

FAMILY PECTINIDAE LAMARCK

GENUS PECTEN MULLER

Pecten (Neithea) morrisi (Pictet and Renevier)

PLATE VII, Figs. 2, 3

Janira Morrisi, Pictet and Renevier, Matér. Pal. Suisse, ser. I, 1853, p. 128, pl. 19, fig. 2.

Pecten (Neithea) morrisi, Woods, Cret. Lam., v. I, 1903, p. 201, pl. 39, figs. 11 a-c, 12 a, b, 13. (Synonymy).

Pecten (Neithea) Morrisi, Pervinquier, Etudes Pal. Tunis, v. 2, 1912, p. 135, pl. 19, fig. 7 a-b.

Pecten (Vola) quinquecostatus Sow. var. *Morrisi*, Sommermeier, Neues Jahrb. für Min., B. B. 36, 1913, p. 387.

Shell of medium size; outline subtriangular, nearly equilateral, slightly oblique; height greater than length; antero- and postero-dorsal margins nearly straight, the latter being slightly longer; ventral margin nearly semi-circular; beak prominent, high, narrow, pointed, incurved, central in position; ornamentation consists of 26 well rounded ribs of which every fifth is raised, giving six principal ribs; interspaces between principal ribs approximately flat; in each interspace there are four subordinate ribs, of which two, central in position, are stronger than the remaining two which may vary slightly in size and lie on each side of and are closely joined to the raised principal ribs; grooves U-shaped, narrower than adjacent ribs; ribs and interspaces marked with fine, regular concentric ridges; posterior area larger than anterior, unmarked except by concentric growth lines.

Dimensions: length, 20 millimeters; width, 10.5 millimeters; height, 23 millimeters.

Three incomplete specimens have been referred to this species. Left valve not present in the collection. The ears and internal characters have been broken away.

Woods makes the following comment:

"The forms found in the lower part of the Lower Greensand are very closely related to *Pecten (Neithea) quinquecostatus*, but show, in general, certain small differences from the latter, so that it will, I think, be convenient to retain for them the name *Morrisi*, given by Pictet and Renevier."

"As a rule *Pecten (N.) Morrisi* is characterised by the relatively greater height of the shell (and consequently smaller apical angle), by the smaller convexity of the right valve, the rather strong main ribs, with the ribs of the interspaces rather more unequal in size, and lastly in having the areas,¹ as a rule, without ribs. The concentric ornamentation agrees with that of *P. (N.) quinquecostatus*."

The specimens in our collection identified as *Pecten morrisi* are clearly distinct from *Pecten quinquecostatus*, and bear all of the characters, pointed out by Woods, which differentiate it from the latter species. It is a widespread Aptian form, and has been described from beds of this age from England, Central Europe, Spain, Portugal, Northern Africa, and Peru.

Collection 317.

¹ This term in this sub-genus refers to the parts of the right valve between the outermost main ribs and the antero- and postero-dorsal margins.

Pecten raimondi Gabb

PLATE VII, Fig. 7

Pecten Raimondi Gabb, Jour. Acad. Nat. Sci. Philadelphia, Second Series, v. 8, p. 293, pl. 42, fig. 1, 1a.

Gabb describes this species as follows:

"Shell oblong flattened, equilateral, slightly inequivalve, closed; surface of both valves covered with strong radiating ribs, about 15 or 16 on each valve. These ribs are surmounted by three ridges, and the intervening grooves carry one or three small radiating lines; all crossed by strong lines of growth becoming slightly squamose on crossing the ridges; anterior right auricle emarginate."

Three poorly preserved and incomplete specimens are referred to this species. In size, ornamentation and general proportions they agree with Gabb's figured specimen.

Type locality: From the "hill of Potasi, on the road from Lima to Jauja, in the mineral region of Morococho."

Type material: Paleontological Collection, Academy of Natural Sciences of Philadelphia.

Collection 6.

FAMILY SPONDYLIDAE FLEMING

GENUS PLICATULA LAMARCK

Plicatula singewaldi n. sp.

PLATE VII, Fig. 1

Shell thin, fragile, inequivalve and inequilateral; outline subovate; antero-dorsal and anterior margins short, convex, passing with broad, gentle curve into broadly arcuate ventral margin; postero-ventral and posterior margins somewhat produced, merging with a rounded angle with postero-dorsal margin which is either slightly curved or nearly straight; right valve always convex, degree variable with the individual; beak anterior, high, slightly produced, bearing scar of attachment; ornamentation consists of numerous rows of fine radial ribs which vary in size and number in different specimens but which are more numerous near margins than near beak, owing to the intercalation of new ribs; interspaces may be equal to, or wider than, the ribs and are either flat or broadly U-shaped; well defined concentric lamellae are present, which are produced where

they cross the ribs into short, spinelike tubercles directed away from the beak and attaining their maximum size at the lower extremity of the lamellae; ornamentation strongest near the margins; left valve nearly flat or slightly concave; ornamentation similar to right valve, but with ribs and spines smaller, more numerous, and more closely spaced.

Dimensions: (right valve) length, obliquely from beak to postero-ventral margin, 20 millimeters; height, measured at right angles to the above dimension, 15 millimeters; diameter, 8 millimeters.

This species is represented in the collection by a number of specimens which present a fairly wide range of variation, expressed principally in the convexity of the right valve, and the number and character of the ribs. Increase in the number of the ribs is commonly accompanied by decreased size with suppressed development of spines. When the ribs are most strongly developed, they are more widely spaced, and bear well developed spine-like tubercles, or nodes. There is also a rather wide variation in the outline. Internal characters not known.

Type material: Holotype and paratypes.

Collection 6.

GENUS PLICATULOPECTEN NEUMANN

Plicatulopecten ferryi (Coquand) var *concentricus* Brügger

PLATE VIII, Fig. 12

Plicatulopecten Ferryi var. nov. *concentricus*, Brügger, Neues Jahrb. für Min B. B. 30, 1910, p. 747, pl. 25, fig. 3.

Shell thin, fragile, equivalve; outline broadly sub-ovate, pointed towards the beaks; postero-ventral area slightly produced; both valves gently convex; beaks central, narrow, pointed; ornamentation consists of strongly defined incremental lamellae which at irregular intervals are produced into conical, hollow tubercles directed away from the beak and arranged along the lower extremity of the lamellae; interspaces between the spines variable in width, and may be U-shaped or nearly flat, smooth or marked by delicate concentric lines which are not continued on the tubercles.

Dimensions of a partly broken specimen: length, 41 millimeters; width (both valves), 10 millimeters; height, 45 millimeters.

This variety, as represented in the collection, is very constant in the development of all of the specific characters. It is distinguished by the strongly developed incremental lamellae, which give the appearance that the component layers have slipped down over each other. The spines occur

only on the lower extremity of the incremental lamellae. The type is from Otusco, Cajamarca, northern Peru, where it occurs in beds of lower Senonian age.

Collection 307.

Plicatulopecten bohmi Neumann

PLATE VII, Figs. 5, 6

Plicatulopecten Bohmi, Neumann, Neues Jahrb. für Min., B. B. 24, 1907, p. 104, pl. 4, figs. 2, 2a-d.

Shell thin, fragile, depressed, equivalve, slightly inflated below beaks, but flattened near the anterior and posterior margins; outline subovate, with irregularly rounded margins; postero-ventral area slightly produced; beak central in position, situated slightly below the cardinal margin, narrow, pointed and separated from the adjacent margins by moderately deep, U-shaped sulci; ornamentation consists of small, rounded, radiating ribs, or columns of hollow, spine-like tubercles, which vary in size and become stronger as they approach the venter; on the anterior half the ribs tend to be nearly straight throughout their extent, while on the posterior half they are gently curved backwards from the beak; interspaces always shallow, gently rounded or flat, and of varying width.

Dimensions: length, 33 millimeters; width, 9 millimeters; height, 35 millimeters.

The type of this species came from La Quinua, about 20 km. north-east of Cerro de Pasco, Central Peru from beds of Santonian age. The genus and species, with its affinities, are discussed at length by Neumann (see synonymy). About thirty specimens in our collection assigned to this species, while very constant in all essential characteristics, show considerable variation in certain details of ornamentation. The radial ribs may be nearly two millimeters in diameter in some cases, and in others may be reduced to fine hair-like lines. The ribs may have a uniform size and all of them may bear hollow spine-like tubercles, or the ribs bearing tubercles may be separated by one, two, or three, smaller ribs which are entirely free from tubercles. The latter arrangement has been described as characteristic of the species *Plicatulopecten hirsatus* Coquand (8, p. 748). Rarely, the ribs may be totally absent, and replaced by a column of spines which at the upper basal extremity persist as slight corrugations of diminishing size until overlapped by another tubercle. Growth lines are usually visible, and the tubercles tend to be arranged in concentric rows suggesting that they were developed as the result of temporary resting

stages. This latter feature is not constant, however, and conspicuous incremental lamellae are rarely formed. When present, the latter do not attain the exaggerated development characteristic of *Plicatulopecten ferryi* var. *concentricus* Brügger (8, p. 747, pl. 25, fig. 3) which is probably a valid variety of the species. A study of the numerous well-preserved specimens of this species furnishes evidence that the above-mentioned variations are but modifications of one highly variable form.

Collections 44, 46, 50, 51.

FAMILY LIMIDAE D'ORBIGNY

GENUS LIMA CUVIER

Lima ellsworthi n. sp.

PLATE IX, Fig. 6

Shell smooth, thin, fragile, of small convexity; valves equal; outline subovate; antero- and postero-dorsal margins nearly straight, the remainder forming a regular curve; umbones small, close together, anterior in position; posterior auriculation small, distinct; ornamentation consists of numerous, straight, well-defined radial grooves, most strongly developed and most closely spaced near antero- and postero-dorsal margins, becoming fainter and more widely spaced toward the center of shell where they are only very faintly suggested; growthlines appear at irregular intervals as scabrous lamellae given shell an obliquely cancellated appearance where they cross the more strongly developed radial grooves near the margins; very fine concentric ridges are present covering the entire surface.

This species is represented in the collection by one fairly well-preserved specimen which shows all of the external characters except the anterior auriculation and the ventral and anterior margins, but the latter features can be inferred fairly accurately from the well-exposed growthline on the higher part of the shell.

Dimensions: length, 10 centimeters; width, 3.2 centimeters; height, 7.5 centimeters.

Type material: Holotype.

Collection 46.

Lima silinensis n. sp.

PLATE VIII, Fig. 1

Cast small, moderately convex, strongly inequilateral, equivalve; outline subquadrangular, oblong; antero-dorsal margin obliquely truncate; antero-ventral margin nearly straight, gently curved upward at the posterior extremity; postero-ventral margin rounded, slightly produced dorsally; postero-dorsal margin straight, parallel with antero-ventral margin; apical angle sharp, about 90 degrees; beaks small, proximate, terminal; ornamentation consists of 14 or 15 rounded ribs which are most strongly developed along the lateral slope and become obsolete near the anterior and posterior extremities; interspaces distinct, U-shaped, slightly narrower than the ribs; fine, concentric growth-lines cross both the ribs and interspaces; numerous close set, very fine, sharp, radial lines and striations extend over the whole surface, giving rise to very fine, obliquely cancellated design near the postero-dorsal margin where they cross the concentric growth lines.

Dimensions of left valve: length, 20 millimeters; height, 19 millimeters; diameter, 5 millimeters.

The collection contains two fairly well preserved external casts of this species, showing the outline, margins, and ornamentation. The ears and internal characters are unknown.

Type material: Holotype.

Collection 317.

FAMILY MYTILIDAE FLEMING

GENUS MODIOLA LAMARCK

Modiola pongana n. sp.

PLATE VIII, Figs. 4, 5

Cast elongate, oblique, slightly inequivalve, inequilateral, inflated in umbonal area, becoming compressed posteriorly; cardinal margin straight, a little over half total length; anterior margin short, rounded; ventral margin broadly convex throughout the anterior half, slightly constricted just behind the medial portion, gently downcurved and produced posteriorly and merging with a gentle curve with the posterior margin; postero-dorsal margin gently arched, oblique, strongly produced; beaks low, rounded, inconspicuous, feebly prosogyrate, almost terminal, having a rounded, narrow ridge (or keel) which extends obliquely toward the

posterior margin, and becoming broader and lower in its posterior extension; the posterior dorsal part of the cast above this ridge is strongly compressed; ornamentation consists of numerous, fine, close set growth-lines which become more widely spaced and pronounced along the posterior and lateral slopes.

Dimensions: length, incomplete, about 55 millimeters; height, 28 millimeters; diameter, 25 millimeters.

The species is described from three incomplete and imperfect external casts. It is probably related to *Modiola* n. sp. aff. *M. flichei* Peron (54, p. 1279, pl. 11, fig. 13), described from the Turonian from Eastern Ecuador. *Modiola pongana* differs from *M.* aff. *flichei* in the following details: it is considerably larger, not as high, proportionally, in the anterior portion, and not as obliquely produced in the postero-ventral extremity.

Type material: Cotypes.

Collection 317.

FAMILY PHOLADOMYACIDAE GRAY

GENUS PHOLADOMYA SOWERBY

Pholadomya quinuana Neumann

PLATE III, Figs. 1, 2

Pholadomya Quinuana Neumann, Neues Jahrb., B. B. 24, 1907, p. 115, pl. 5, fig. 2.

Cast fairly large, equivalve, strongly inequilateral, highly inflated dorsally, attaining greatest convexity about midheight in front of the middle part, and becoming gradually depressed toward the venter; roughly subtrigonal in outline, anterior margin rounded, slightly produced beyond the beaks, and merging with a broad and gentle curve with the ventral margin which is gently curved in front and nearly straight posteriorly; posterior extremity strongly produced; beaks large, broad, strongly incurved, proximate, moderately elevated above the hinge line, anterior in position, feebly prosogyrate; ornamentation consists of numerous, irregularly developed, rounded costae, of moderate strength, which tend to be sharp-crested where they originate on the beaks but become broader and more rounded as they radiate toward the ventral margins, and become obsolete on the anterior slope; the costae are very slightly curved forward in the umbonal area and backward as they approach the ventral margin; they are not equally spaced but are always narrower than the shallow, U-shaped interspaces; irregular, concentric undulations and growth lines

extend over the entire surface, and occasionally produce a slight increase in the size of the radial costae where they cross the latter.

Dimensions: length, 75 millimeters; diameter (both valves) 37 millimeters; height, 47 millimeters.

This species is represented by two somewhat fractured and incomplete casts, and is believed to be identical with the form described by Neumann, as it agrees with his figured specimen very closely in size, proportion, and ornamentation. The dimensions given by Neumann are as follows: length, 80 mm.; width, 35 mm.; height, 50 mm. Although the difference in dimensions is insignificant, it is highly probable that the agreement of the two forms was originally closer, as portions of the umbonal and posterior portions of our cast have been broken away. The marginal outline of our specimen agrees almost perfectly with that of Neumann's specimen. The greatest difference between the two forms is to be found in the number of radial costae, but the discrepancy is not great enough to be of significance. The size of the costae, the curvature, direction, as well as the manner in which they become rounded and broader as they approach the ventral margin, is identical. *Pholadomya quinuana* was described from the "Santonian-Campanian beds" of La Quinua, Department of Cajamarca, where it is found associated with *Ostrea nicaisei*. It is significant that our specimen likewise occurs in beds with *Ostrea nicaisei*.

Collections 46, 50.

Pholadomya pongensis n. sp.

PLATE VIII, Figs. 8, 9

Cast of medium size, equivalve, strongly inequilateral, highly inflated dorsally, attaining greatest convexity at about midheight in front of the middle, and only slightly less inflated ventrally; beaks highly inflated, broad, strongly incurved, proximate, moderately elevated above the hinge line; ornamentation consists of 8 to 10 faint, broadly rounded, nearly equally spaced radial ridges which are present only on the umbonal and dorsal areas, becoming obsolete or exceedingly faint toward the ventral and posterior margins; irregular concentric undulations extend over the entire surface, producing distinct but faint nodes where they cross the radial costae, and imparting a lightly cancellated appearance to the umbonal portion of the cast.

Dimensions of external cast having both valves: length, 45 (plus) millimeters; height, 32 millimeters; diameter (both valves) 30 millimeters.

This species is represented by one external cast of which the anterior

ventral portion has been obliterated. The general form of the cast suggests that the outline was roughly subtrigonal.

This species varies from *Pholadomya quinuana* Neumann in the following details: it is only about half as large, and is much shorter proportionally. The ribs are much fewer and not as strongly developed, and do not extend to the ventral margin. This species is also more highly inflated, giving it a rather globose appearance. The ventral slope is rounded, while that of the other is nearly straight.

Collection 6.

Pholadomya sp.

PLATE VIII, Figs. 2, 3

Cast short, wide, equivalve, inequilateral, highly ventricose; beaks high, proximate, incurved, faintly prosogyrate, highly inflated, anterior in position; ornamentation, except on posterior slope, which is smooth, consists of numerous very fine, narrow ribs which originate on the beaks and extend to the ventral margin; about one third of the distance from the beaks to the margin a secondary set of ribs appear in the middle of the interspaces, and gradually approach the size of the primary ribs, which they attain fully near the ventral margin; the ribs are irregularly interrupted by frequent concentric undulations and growth lines which impart to the cast a minutely and obliquely checkered appearance; the concentric undulations extend over the posterior slope.

Dimensions: length, incomplete; diameter, 29 millimeters; height, incomplete.

One imperfect cast has been referred to this species. The anterior slope and margins have been obliterated, and the remaining margins have been deformed or mutilated to such an extent that they are of little or no descriptive value. In general form and size this species somewhat resembles *Pholadomya pongensis*, but differs from the latter in the following details: it is smaller, shorter and more highly inflated in proportion. The principal distinction is found in the ornamentation, which as shown by the above description, is very dissimilar.

Collection 34.

Pholadomya silinensis n. sp.

PLATE VIII, Figs. 6, 7

Cast of medium size, strongly inequilateral, highly inflated in the umbonal area, attaining greatest convexity about midheight in front of the

middle part of the cast, gradually depressed toward the venter and the posterior portion; inequilateral, left valve slightly higher and more inflated than the right; outline elongate, oval; antero-dorsal margin short, straight, obliquely produced; ventral margin broadly arcuate, strongly produced posteriorly, curved upward at the anterior extremity making a sharp obtuse angle with the antero-dorsal margin; postero-dorsal margin nearly straight, long, very obliquely produced, merging gradually with the rounded posterior margin; anterior slope short, abrupt; posterior slope nearly straight, long, very gradually produced, attenuated; beaks strongly, evenly inflated, broad, prosogyrate, proximate, strongly incurved so that the apexes nearly touch the hinge-line, and having a narrow, elliptical, excavated smooth area just below them; ornamentation consists of about 8 broadly rounded, straight, rather widely spaced costae which run obliquely from the beaks to the ventral margin, are most strongly developed near the ventral margin, less conspicuous near the beaks, and obsolete on the anterior and posterior slopes; interspaces broad, shallow, U-shaped, of irregular width, but always much broader than the ribs; irregular, concentric incremental undulations extend over the entire surface of both valves, except the elliptical smooth area just below the beaks, and produce low, rounded nodules where they cross the radial costae.

Dimensions: length, incomplete, 50 millimeters; height, 29 millimeters; diameter, both valves, 29 millimeters.

This species has been described from one poorly preserved external cast. In size, ornamentation and degree of inflation it closely resembles *Pholadomya pongensis*, but differs from the latter in the following details: it is much more elongate, the radial ribs are directed backward at a more oblique angle, and they persist farther toward the postero-dorsal margin.

Type material: Holotype.

Collection 317.

FAMILY ANATINIDAE DALL

GENUS ANATINA LAMARCK

Anatina silinensis n. sp.

PLATE VIII, Figs. 10, 11

Cast of medium size, inequilateral, evenly inflated throughout umbonal and dorsal area, attaining greatest convexity across the posterior side of the beaks, depressed ventrally, and having a constriction which is faint

and narrow on the anterior portion of the umbonal area but which becomes broader and more pronounced directly under the beaks toward the venter; inequivalve, right valve slightly more inflated than the left; outline oblong, subelliptical; cardinal margins very broadly arched; ventral margin broadly convex, contracted directly under beaks at the termination of the constricted area; anterior margin broadly rounded, forming rounded obtuse angles where it merges with the ventral and posterior cardinal margins; beaks small, flattened, incurved, slightly distant, with a moderately broad, deep, U-shaped fissure running obliquely from the posterior side of the beak, and becoming obsolete as it approaches the side; surface ornamented by numerous, fairly strong, rounded, irregularly developed concentric ridges bearing fine concentric lines which are exposed on the ventral portion of the cast.

Dimensions: length (incomplete) 5.5 centimeters; width (both valves) 2.3 centimeters; height, 3.5 centimeters.

This species is represented by only the external cast, the posterior extremity of which has been broken away. It is possible that the fine, concentric lines which are present on the ventral portion of the cast persisted over the entire surface of the shell, but have been subsequently destroyed. The species is characterized by the fissure posterior to the beaks and by the constriction below them.

Type material: Holotype.

Collection 317.

FAMILY POROMYACIDAE DALL

GENUS LIOPISTHA F. B. MEEK

Liopistha sp. aff. *Liopistha (Psilomya) gigantea* Sowerby

PLATE VIII, Fig. 13

Cast fairly large, subovate, highly inflated, inequilateral; anterior margin short, gently curved dorsally, rounded ventrally; ventral margin broadly arcuate; posterior margin produced, rounded; postero-dorsal margin oblique, straight; beaks highly inflated, high, pointed, strongly incurved, prosogyrate, proximate; an inconspicuous, rounded keel runs from the front of the beaks to the lower part of the anterior margin, bordering an irregularly concave smooth area below the beaks; ornamentation consists of numerous, closely-set, evenly spaced, rounded, concentric ribs which begin at the anterior keel and run to the postero-dorsal and posterior margins; interspaces broadly U-shaped, shallow, not as wide

as the adjacent ridges; ribs, well developed on beaks, reach maximum size half way from beak to ventral margin, and become weaker and more closely spaced as they approach the venter.

This species has been described from three fragmentary casts. The margins are not preserved on any of the specimens, but can be determined from the well-preserved concentric ornamentation. In ornamentation and general proportions this species closely resembles *Liopistha (Psilomya) gigantea* Sowerby (figured in Pervinquière, *Etudes de Paléontologie Tunisienne*; Atlas, pl. XX, figs. 21, a and b.) but the material at hand is too poor for exact specific determination.

This species has been reported by Sommermeier (63, p. 374), but without figures or description, from Cajamarca, S. Cachachi, W. Celendin, and from Cochamarca, Hac. Calluan (El Monton), San Marcos, Northern Peru, where it occurs in the Albian and Cenomanian.

Collections 6, 348, 317, 316.

Liopistha sp. aff. *Liopistha (Psilomya) alta* F. Roemer

Cast large, cardiform, highly inflated, inequilateral, inequivalve; antero-dorsal margin obliquely truncate; anterior margin vertical near upper limit, merging with a broad curve with the ventral margin; ventral margin broadly arcuate, slightly produced posteriorly; beaks high, prominent, highly inflated, strongly incurved, proximate, situated one just behind the other in the medial portion of cast; ornamentation consists of numerous, close-set, evenly spaced, rounded, concentric ribs.

Dimensions: length, incomplete, about 70 millimeters; height, 61 millimeters; diameter, both valves, 50 millimeters.

This species has been described from one poorly preserved and incomplete internal cast, which has the external features faintly preserved near the beaks. In outline and general proportions it closely resembles *Liopistha (Psilomya) alta* F. Roemer (47, p. 293, pl. 20, figs. 20 a-b). This species differs from the specimen figured by Roemer (55, p. 45, pl. 6, figs. 11, 12) in size, being much larger, and also by having the anterior margin more strongly produced, especially in the upper portion.

Collection 317.

FAMILY PLEUROPHORIDAE DALL

GENUS ROUDAIRIA MUNIER-CHALMAS

Roudairia intermedia Brüggen

PLATE X, Figs. 1, 2, 3, 4

Roudairia intermedia, Brüggen, Neues Jahrb. für Min., B.B. 30, p. 756, pl. 26, fig. 2.

Shell small, moderately heavy, inflated, equivalve; outline triangular; anterior margin short, slightly produced, merging with a broad, gentle curve into the ventral margin which is straight and approximately horizontal medially, and slightly down-curved near its posterior extremity; posterior margin obliquely truncate, with a slight downward flexure at the middle; beaks high, narrow, pointed, incurved, in contact, feebly pro-sogyrate, slightly anterior in position; a sharp, prominent keel formed by the lateral extension of the posterior area extends from the beak to the postero-ventral angle; the anterior surface is ornamented by 10 to 12 rounded, smooth, concentric ribs which are largest where they terminate abruptly against the keel and become gradually attenuated before they converge under the beak; interspaces well-defined, smooth, and V-shaped; the posterior area, which is bounded by the prominent lateral keel, bears a low, rounded obscure ridge which extends from the beak to the middle of the postero-dorsal margin; between the keel and the ridge there extends a broadly concave depressed area; the posterior area is ornamented only by narrow, inconspicuous growth lines.

Dimensions: length, 17 millimeters; width (both valves), 16 millimeters; height, 16 millimeters.

Several well preserved specimens are referred to this species. They agree in every detail of surface ornamentation and proportions with the description of Brüggen. The internal characters are not known. The only obvious difference is in the size. For example Brüggen's original description gives the following dimensions:

Length and height, 3 cm.; width, 1.7 cm.

The original description is made from material from beds considered of Senonian age from Atusco, Cajamarca, from San Pedro, and from the Pachitea river, northern Peru.

Brüggen points out that "this form bears a very close similarity to *R. auressensis* Coquand and to *R. Forbesi* Stol. (80, pp. 299, 295, pl. 29, figs. 10-12, 4-5). The peruvian forms are distinguished from *R. auressensis* by their more numerous and less strongly developed ribs, and from *R. Forbesi* by their triangular outline and by the development of the posterior

area which is not very high and is perpendicular to remaining surface of the shell."

"*R. auressensis* is thus far known from the Santonian to the Danian of Tunis and Algiers, as well as from the Santonian of the Lybian Desert (51a, p. 221, pl. 24, figs. 20-22) and from Kamerun (62, p. 230). *R. Forbesi* is known from the Santonian of Tunis and Algiers, the Santonian of Angola (13a, p. 42, pl. 1, fig. 3) and from the Trichinopoly group of India (79, p. 197, pl. 9, figs. 2-8)."

It is possible that the form referred to this species by Reeside (54, pl. 10, figs. 2, 3) may be closely related to our species, but the greater number of less strongly developed ribs suggests that it may be more closely related to *R. auressensis*.

Collection 42.

GENUS ANISOCARDIA MUNIER-CHALMAS

Anisocardia ? sp.

PLATE X, Figs. 5, 6

Cast small, equivalve, inequilateral, very highly inflated; outline subtrigonal; antero-dorsal margin obliquely truncate; anterior margin rounded, very slightly produced beyond beaks and merging with a broad and gentle curve into ventral margin which is broadly curved in front and nearly straight in its posterior extension; postero-dorsal margin very broadly arched, oblique, produced, forming a rounded acute angle with ventral margin; anterior slope vertically truncate, so that all of cast anterior to beaks is flat; posterior slope more gently rounded and oblique; beaks strongly inflated, prominent, incurved but not in contact, feebly prosogyrate, and having a broad, shallow excavated area immediately anterior to them; ornamentation suggested by numerous rather closely spaced and very faint concentric lines.

Dimensions: length, 27 millimeters; height, 30.5 millimeters; diameter (both valves) 30 millimeters.

One weathered, external cast is doubtfully referred to this genus on the basis of its general outline and appearance. The character of the hinge is unknown and the ornamentation is not well enough preserved to be of any value.

Collection 327.

FAMILY CARDIIDAE FISCHER

GENUS CARDIUM LINNÉ

Cardium watsoni n. sp.

PLATE X, Fig. 12

Shell of medium size, strong, equivalve, very inequilateral, highly inflated; subovate or roughly subtrigonal in outline, anterior margin truncate; ventral margin well rounded, postero-ventral margin produced; posterior margin slightly curved ventrally, nearly straight in its medial portion, and becoming broadly curved dorsally; anterior dorsal slope straight and very steep; posterior dorsal slope slightly curved and less steep; beaks incurved, pointed and proximate, rather conspicuous and rising well above the hinge, gently prosogyrate and anterior in position; ligament external, very short, situated in narrow groove just behind the beaks; ornamentation consists of about 30 radial ribs which originate on the beak, where they are small and evenly rounded; the ribs increasing in size as they approach the margins; one rib extends directly along the angle between the side and posterior slope and is somewhat conspicuous because of the sudden break in the contour of the shell due to the steepness of the posterior slope; 10 ribs are present in front of the angle and are flat-topped and broad, formed by narrow grooves or lines which become increasingly shallow until they disappear on the anterior dorsal slope near the margin; 19 well rounded ribs are present behind the angle, near which they are most prominent and separated by interspaces which are deep and fairly broad but which become more closely spaced and shallower until they totally disappear on the slope adjacent to the cardinal margin; ribs on ventral margin notched so that interspaces of opposite valve fit into the notches; concentric striae and growth-lines are present on the whole of shell but are especially prominent near the margins and on the venter.

Dimensions: length, 28 millimeters; width (both valves), 30 millimeters; height, 36 millimeters.

Type material: Holotype.

Type locality: Collection 30.

Collections 30, 307.

Cardium centralis n. sp.

PLATE X, Fig. 7

Cast of medium size, equivalve, inequilateral, highly inflated; outline roughly subovate: anterior margin rounded and merges with a broad,

gentle curve into ventral margin which is rounded and somewhat produced in its posterior extremity, forming an open, rounded angle with the posterior margin which is broadly and evenly arched; postero-dorsal margin short and strongly curved; anterior dorsal slope steep and gently curved; posterior dorsal slope broadly curved and much less abrupt; beaks incurved, pointed orthogyrate, proximate, conspicuous and rising well above the hinge; ornamentation consists of about thirty rounded, fairly strong ribs which are most fully developed near the inconspicuous, rounded angle between the side and posterior slope extending from the beak to the angle of the postero-dorsal margin; the ribs decrease in size and become more closely spaced away from the postero-dorsal ridge until they become obsolete near the postero- and antero-dorsal margins.

This species is known only from casts. It is very similar in size and ornamentation to *Cardium watsoni* but is clearly distinguished from the latter by having a shorter and more circular outline, and by the fact that it is less inflated, and has a more evenly rounded and flatter horizontal cross-section.

Dimensions (right valve): length, 27 millimeters; width, 10 millimeters; height, 29 millimeters.

Type material: Holotype.

Type locality: Collection 51.

Collections 51, 307.

GENUS PROTOCARDIA BEYRICH

Protocardia berrii n. sp.

PLATE XI, Figs. 1, 2

Shell of medium size, moderately heavy, trigonal, highly inflated, inequilateral, equivalve; anterior margin truncate dorsally, merging with a broad and gentle curve into the ventral margin which is very broadly curved and nearly horizontal; postero-dorsal margin evenly and gently arched, oblique, forming a rounded obtuse angle with the ventral margin; beaks prominent, pointed, highly inflated, incurved, faintly proogyrate, distant, anterior in position, with a prominent angle between the side and posterior slope extending from in front of the beak to the lower extremity of the posterior margin; ornamentation, except on the posterior slope, consists of numerous, regularly rounded, smooth, concentric ridges which are slightly unequal in size; interspaces narrow, U-shaped; posterior slope ornamented by about 20 fine, closely spaced radial ribs which are crossed by faint growth lines; lunule suggested by a deeply

excavated area starting just below the beaks and extending about half the length of the anterior margin; anterior adductor scar (seen on the cast), small, subovate in outline, deep at upper limit, faint ventrally, situated high and near the distal extremity of the dorsal margin.

Dimensions: length, 45 millimeters; height, 46 millimeters; diameter, (both valves) 37 millimeters.

This species is represented in the collection by one partly complete shell and three imperfect casts. It is doubtlessly closely related to *Cardium* (*Protocardia*) *Coquandi* Sequenza (48, p. 266, pl. 19, fig. 22 a-c), but differs from the latter in the following details: *Protocardia berrii* has considerably greater diameter, proportionally, and is more highly inflated. The postero-ventral marginal angle is sharper and wider in the latter, and the ventral and antero-ventral margins are more produced.

Type material: Cotypes.

Collection 316.

Protocardia n. sp. aff. *P. hillana* Sowerby

PLATE IX, Figs. 1, 2, 3

Shell thin, fragile, equivalve, nearly equilateral, moderately inflated; outline subcircular to subquadrate; length greater than height; antero-dorsal margin short, forming a rounded angle with anterior margin; anterior margin convex and passing with broad, gentle curve into broadly arcuate ventral margin; postero-ventral margin slightly produced, merging with rounded obtuse angle into postero-dorsal margin which is obliquely and broadly curved; beaks slightly anterior, high, pointed, moderately inflated, incurved, proximate; ornamentation, except on posterior slope, consists of fine, regularly rounded concentric ribs which become less prominent or obsolete dorsally; posterior slope bears 12 to 15 radial ribs, stronger than concentric ribs, transversely divided at crests by narrow grooves, giving rise to numerous, closely spaced tubercles; interspaces about same width as ridges; inner surface of shell smooth, reflecting surface ornamentation only near ventral and dorsal margins; adductor scars moderately large, subcircular in shape, deep at upper limits, faint ventrally, of equal size, situated high, and near distal extremities of dorsal margins; pallial line simple, quite deep, parallel to margins.

Dimensions of external cast having the two valves: length, 43 millimeters; height, 39 millimeters; diameter, 22 millimeters.

This species has been described from abundant material, and is very constant in ornamentation, general proportions, and size. It is undoubtedly

ly related to *Protocardia hillana* (Sowerby), but is referred to a new species because the latter name has been loosely applied to dissimilar fossils from Mexico (6, p. 129, pl. 27, figs. 4-5), Europe (84, v. 2, pt. 1, p. 197, pl. 32, figs. 1-6), Africa (48, p. 264), and India (79, p. 219, pl. 12, figs. 8-10; pl. 13, figs. 1-5), and from sediments ranging in age from Albian through Senonian.

Type material: Cotypes.

Collection 6.

Protocardia meridionalis n. sp.

PLATE X, Figs. 15, 16, 17

Shell thin, fragile, subequivalve, nearly equilateral; outline subovate, regular; length about one third greater than height; anterior margin evenly rounded, produced; ventral margin broadly arcuate; postero-ventral and posterior margins produced farther than anterior margin, forming a sharper curve; postero-dorsal margin more broadly curved and longer than antero-dorsal so that at anterior end the shell is a little shorter than the posterior and more narrowly rounded; beaks large, inflated, slightly anterior, faintly prosogyrate, strongly incurved, proximate; right valve inflated slightly more than left, and with higher and more prominent beak; ornamentation, except on posterior slope, consists of fine, regularly rounded concentric ribs which become obsolete dorsally; posterior slope bears about 15 radial ribs, stronger than concentric ribs, transversely divided at crest by narrow grooves, giving rise to numerous, closely spaced tubercles; interspaces about same width as ridges; inner surface of shell smooth, reflecting surface ornamentation only near ventral and dorsal margins; adductor scars small, subcircular in shape, rather faint, situated high and near distal extremities of dorsal margins.

Dimensions: length, 48 millimeters; height, 33 millimeters; diameter, 21 millimeters.

This species is very closely related to *Protocardia* aff. *hillana*, having identically the same ornamentation. It differs from *P.* aff. *hillana* in its general outline, which is much longer and not as high. They both occur at the same horizon.

Type material: Cotypes.

Collection 6.

FAMILY VENERIDAE LEACH

GENUS PAPHIA BOLTEN

Paphia peruana n. sp.

PLATE X, Figs. 13, 14

Cast of large size for the genus, compressed, equivalve, inequilateral; ellipsoidal in outline; dorsal margin nearly straight, slightly oblique, subparallel to ventral margin which is broadly arched; anterior margin arcuate, slightly constricted directly in front of beaks; posterior margin produced, beaks very low, slightly inflated, with sharp and prosogyrate apices placed within the anterior third, and with a short, narrow, deeply excavated area, suggesting lunule, directly in front of them; surface smooth.

Dimensions: length, 32 millimeters; height, 21 millimeters; diameter, 11 millimeters.

Type material: Holotype.

Collection 6.

CLASS GASTROPODA

FAMILY EPITONIIDAE DALL

GENUS EPITONIUM BOLTEN

Epitonium pongensis n. sp.

PLATE X, Fig. 8

Cast of medium size, elongate, turreted; whorls about 5 or more, broadly arched, regularly increasing in size, contiguous; apical angle about 30 degrees; suture line deep, sharp, and close; surface marked by faintly oblique rib-like varices which have a slightly backward direction in crossing from the upper to the lower side of the whorl; the varices are low, rounded and fairly broad proportionally, and nearly straight or else very slightly curved forward near the posterior extremity and recurved at anterior extremity, disappearing just before reaching the suture line, about 24 on the body whorl and decreasing in number on the preceeding whorls; numerous very fine, closely spaced spiral lines are present on the anterior portion of the body whorl.

Dimensions: length (incomplete) 35 millimeters; width, 17 millimeters; apertural length, about 14 millimeters; length of spire (incomplete) 21 millimeters.

This species has been described from one internal cast which has had one or two of the earliest whorls and the apertural features broken away. It bears some resemblance to *Scalardia texana* Romer (55, p. 39, pl. 4, fig. 11 a-b) but is distinguished from the latter by its smaller size, slower rate of coiling, and more rounded aperture. The fine apiral lines which are partly shown on the body whorl of our species persist over the entire surface of *S. texana*.

Type material: Holotype.

Collection 6.

FAMILY NATICIDAE FORBES

GENUS NATICA SCOPOLI

Natica lesseli Brüggén

PLATE XII, Figs. 1, 2

Natica lesseli, Brüggén, Neues Jahrb. für Min., B. B. 30, 1910, p. 737, text fig. 16.

Cast large, globose; spire moderately high; whorls 4 to 5 in number, regularly increasing in size, evenly and broadly arched laterally, sharply angulated at their posterior extremity, and separated by a wide, deep furrow; body whorl over half of total length; umbilicus wide, deeply excavated, with the lower extremity of the adjacent whorl sharply angulated.

Dimensions: length, 10.1 centimeters; width, 7.3 centimeters.

Six fractured and poorly preserved specimens which do not reveal the apertural characters, ornamentation, or protoconch, are referred to this species. In general proportions, size, and especially in the character of the umbilicus, the specimens at hand agree very closely with the type which Brüggén described and figured from beds said to be of Senonian age from Otusco, near Cajamarca, and from Yanamatray, northern Peru.

Brüggén compares this species with *N. pedernalis* Römer (55, p. 43, pl. 4, fig. 1 a-b) from the Neocomian of Texas, but points out that the sharp angulation of the body whorl, adjacent to the umbilicus, is lacking in the latter form.

Collection 307.

Natica ? sp. indet.

PLATE X, Fig. 9

Cast small, naticoid; spire depressed but elevated well above the body whorl; whorls 4 or 5 in number, closely appressed, increasing markedly in

size, slightly angulated posteriorly near the suture but without a distinct shoulder; body whorl inflated, rounded anteriorly, flattened posteriorly and broadly arched medially.

Dimensions: length, 16 millimeters; width, 18 millimeters.

One incomplete cast is doubtfully referred to this genus. It is too incomplete for the characterization of a new species, and its affinities cannot be determined.

Collection 316.

Natica cf. *larteti* Landerer

PLATE X, Figs. 10, 11

Cast of moderate size, ovate, globose; spire short, low formed by about 4 whorls which are moderately but regularly convex; last whorl greatly enlarged; whorls separated by a wide, deeply excavated furrow; posterior margins of the whorls angulated above the furrow; umbilicus broad, deep.

Dimensions of an imperfect specimen: length, 53 millimeters; width, 51 millimeters.

One specimen which is too poorly preserved for complete characterization and which cannot be determined with any degree of certainty is doubtfully referred to this genus. It does not bear close resemblance to any species of the genus, known to the writer, from South America, but appears to represent a species very similar to *Natica larteti* Landerer (48, p. 46, pl. 4, fig. 1 a-b) which occurs in the Turonian of Tunis.

Collection 307.

Natica n. sp.

Cast of small size and naticoid; spire depressed, with an elevation of slightly less than half the entire length; whorls 5 or 6 in number, increasing rapidly in size; suture impressed; body whorl considerably flattened posteriorly, sharply angulated at the posterior extremity above the suture, broadly rounded anteriorly, and broadly arched medially; aperture subovate in outline, broadly flaring near exterior margin; umbilicus prominent.

Dimensions: length, 25 millimeters; width, 23 millimeters.

This species is characterized particularly by its small size and by the widely flaring outer margin of the aperture. It is distinguished from *Natica Gastelumendi* Berry (3, p. 86, figs. 6, 7) by its larger size, higher spire, and greater number of whorls.

Collection 307.

FAMILY TURRITELLIDAE GRAY

GENUS TURRITELLA LAMARCK

Turritella roscheni n. sp.

PLATE V, Fig. 2

Shell of medium size, thin; outline elongate, turreted; whorls about 10, lateral surface concave, regularly increasing in size, converging at an angle of approximately 25 degrees; spiral sculpture consists of two primary ribs; one rib situated at the upper extremity of the whorl, adjacent to the suture; it is strong, broad, and usually bears at the summit rather closely spaced, rounded tubercles which are most prominent on the later whorls; the second primary rib is situated at the lower extremity of the whorl, is strong, rounded, but slightly narrower than the upper rib; the interspace is regularly broadly concave, most deeply excavated just below the upper rib, and is marked by 4 or 5 very fine striae on the later whorls; three closely spaced secondary spiral costae are present on the lower slope of the whorls, but are usually concealed by the succeeding whorls, altho the uppermost of the three may be visible in the latest whorls; suture not strongly impressed, situated in a narrow, V-shaped furrow; inconspicuous growth lines are present on the later whorls.

Dimensions: length, 26 millimeters; width, 7 millimeters; apertural length, 10 millimeters; length of spire, 16 millimeters.

This species has been described from several poorly preserved and somewhat crushed specimens which show only the ornamentation well. The protoconch and aperture have not been preserved.

Type material: Cotypes.

Collection 134.

Turritella sp. indet.

PLATE IX, Fig. 4

Cast of medium size, elongate, turreted, the apical angle about 20 degrees; number of whorls preserved, 7; whorls moderately close, surface smooth and rounded, curving rather abruptly into the suture above and below; suture deeply impressed, situated in a deep, wide, rounded, revolving furrow; ornamentation suggested by about 4 very faint, evenly spaced spiral lines.

Dimensions: length, 39 millimeters; width, 6 millimeters.

Several internal casts of this *Turritella* are represented in the collection. All exterior ornamentation and other specific characters have been lost, so that the description of a new species is impossible. Its affinities cannot be determined.

Collections 46, 50, 51.

FAMILY FUSINIDAE TYRON

GENUS FUSINUS RAFINESQUE

Fusinus ? sp. indet.

PLATE IX, Fig. 5

Cast of medium size, fusiform; spire elevated and acute, increasing moderately in size; apex broken away; body whorl large, moderately inflated, broadly arched, sharply angular posteriorly, constricted in front; suture impressed; ornamentation consists of numerous low, gently rounded, and slightly oblique rib-like varices which persist from suture to suture on the whorls of the spire, but which become obsolete on the anterior portion of the body whorl; aperture moderately narrow, produced into a narrow, open canal; columella and parietal wall smooth.

Dimensions: length (incomplete) 40 millimeters; width, 25 millimeters.

One poorly preserved internal cast is doubtfully referred to this genus. The actual length cannot be ascertained because the apex of the spire and the oral canal have been broken away, but the outline of the remainder suggests that they were of the length characteristic of the genus. If the parietal wall of the shell bore any plications, they were not of sufficient strength to leave any impression on the cast.

Collection 36.

FAMILY VOLUTIDAE GRAY

GENUS VOLUTOLITHES SWAINSON

Volutolithes ? sp. indet.

PLATE XI, Figs. 3, 4

Cast large, fusiform; spire elevated, conical, with 4 or 5 whorls which increase in size regularly and are separated by a fairly narrow but deep furrow; whorls very broadly arched, with a prominent, rounded shoulder

behind which there extends a shallow sulcus; body whorl broadly arched and contracted in front into a broad, anterior canal; ornamentation consists of about 15 strong, rounded radial ribs which increase in size backwards from the anterior sulcus and terminate at the shoulder; the ribs are separated by broad, moderately deep, U-shaped interspaces.

Dimensions: length, incomplete; diameter, 7 cm.

Three broken and weathered casts are doubtfully assigned to this genus. The specimens are characterized by their large size, and by the strong radial ribs.

Collection 307.

PART III

CEPHALOPODA

by

MAXWELL M. KNECHTEL

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PART III

Class CEPHALOPODA

Order AMMONOIDEA

THE TITHONIAN SPECIES

FAMILY STEPHANOCERATIDAE: SUB-FAMILY PERISPHINCTINAE

GENUS PERISPHINCTES WAAGEN

The name *Perisphinctes* is used in this paper in a broad sense, no attempt having been made to separate the genera which have been created in recent years for the various species originally assigned to this genus.

Perisphinctes cf. *contiguus* (Catullo) Zittel

PLATE XIII, Figures 1, 2, 3

The greatest thickness of the whorl, which is a little less than its height, is near the umbilical shoulder. There is no demarcation between the sides and the rounded venter. The umbilicus is wide. The ribs are narrow and subacutely crested. They are rather widely spaced on the inner half of the sides and most of them bifurcate about half-way from the umbilical shoulder, the anterior branch of each passing across the venter without further division, while the posterior branch usually bifurcates a second time a short distance from the first point of division. The ribs are uninterrupted on the venter and many of them alternate as seen in Figure 1.

In form and ornamentation the examples in hand are similar to the figured specimens of Toucas (81, p. 581, pl. 14, fig. 4) and Burckhardt (12, p. 38, pl. 4, figs. 7-10).

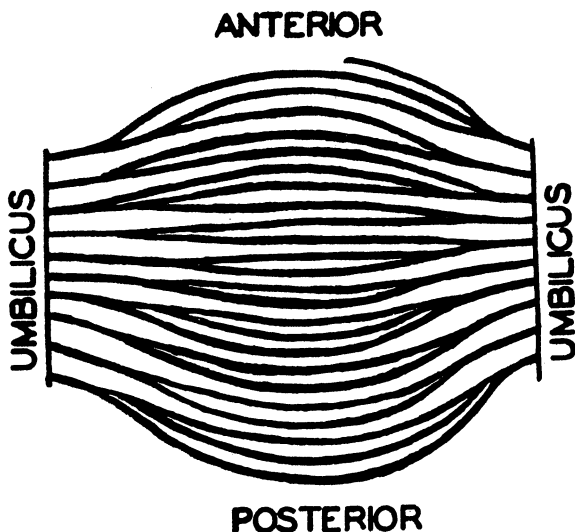


FIGURE 1. Diagram, showing alternation of some ribs in *Perisphinctes* cf. *contiguus* (Catullo) Zittel. Individual shown in Plate XIII, figs. 1, 2, 3. $\times 1$.

Perisphinctes aff. *densistriatus* Steuer

PLATE XIII, Figures 4, 5, 6

Perisphinctes aff. *densistriatus* Steuer. Welter, O. A., Neues Jahrb., Jahrgang 1913, v. I, p. 36.

The whorl attains its greatest thickness, which is about equal to its height, near the umbilical shoulder. The umbilicus is wide and its wall steep. The sides converge very gently outward to a distinct increase in convexity that separates them from the rounded venter. Most of the ribs bifurcate only once on the outer third of the whorl, but others bifurcate about half-way out, the anterior branch passing across the venter without further division, whereas the posterior branch divides again on the outer third of the whorl. The primary ribs alternate on the venter in much the same manner as *Perisphinctes* cf. *contiguus* (Catullo) Zittel (fig. 1). At least one constriction occurs on the anterior portion of the outer whorl.

Tentative identification of specimens in hand as *Perisphinctes* aff. *densistriatus* is suggested by Welter's meager description and their general resemblance to the individuals illustrated by Steuer (77, pl. 15, figs. 8-10) and Burckhardt (11, pl. 24, fig. 7).

Perisphinctes cf. gevreysi Toucas

PLATE XIV, Figures 6, 8, 9

The greatest thickness of the whorl, which approximates its height, is attained near the umbilical shoulder. The umbilicus is wide. The sides are much less convex than the well rounded venter. On the figured specimen, all of the ribs bifurcate once near the indefinite ventro-lateral margin, but on another, less well preserved specimen, an additional branch occasionally separates not far from the umbilical shoulder and crosses the venter without further division. The ribs do not alternate as in *Perisphinctes cf. contiguus* (Catullo) Zittel and *Perisphinctes aff. densistriatus* Steuer and are uninterrupted on the venter, where they are slightly convex forward. The siphuncle is apparently circular in cross section.

In form and ornamentation this specimen closely resembles *Perisphinctes gevreysi*, as described and figured by Toucas (81, p. 583, pl. 14, fig. 5).

Perisphinctes cf. pouzinensis Toucas

PLATE XIV, Figures 1, 2, 3

The greatest thickness of the whorl occurs about half-way out from the umbilicus. The umbilical wall is very steep and the umbilicus is wide. The height of the whorl is a little greater than its thickness. There is no demarcation between the sides and the rounded venter. Closely spaced, subacutely crested ribs arise at the umbilical margin and bifurcate, or, occasionally, trifurcate, on the outer third of the sides. They pass uninterruptedly across the venter and the primary ribs apparently alternate in somewhat the same way as in *Perisphinctes cf. contiguus* (Catullo) Zittel (fig. 1). A single constriction appears on the completely preserved cast of the outer whorl of a specimen in the collection; it inclines forward from the umbilicus to the ventral region.

As in the specimen described and figured by Burckhardt (11, p. 45, pl. 24, fig. 8), the section of the whorl is a little stouter than that figured by Toucas (81, p. 584, pl. 14, fig. 6).

Perisphinctes aff. tiziani Oppel

PLATE XV, Figures 4, 5, 6

? *Perisphinctes tiziani* Oppel. Welter, O. A., Neues Jahrb., Jahrgang 1913, v. 1, p. 35.

The section of the whorl is subcircular and the umbilicus is wide. The ribs arise at the umbilical margin, bifurcate on the sides, and cross the

venter uninterruptedly. The ribs on the cast are narrow and subacutely crested, and are separated by rounded and very much broader interspaces. The ribs do not alternate as in other species of *Perisphinctes* herein described.

In general aspect this specimen is similar to *Perisphinctes tiziani* as figured by Burckhardt (11, pl. 34, fig. 3; pl. 25, fig. 2), and may therefore be identical with the form Welter identified with Burckhardt's figure but did not describe.

Perisphinctes sp.

PLATE XIV, Figures 4, 5, 7

The maximum thickness of the whorl is near the umbilical shoulder and is about equal to the height of the whorl. In cross section the whorl is more or less subquadrate, with broadly rounded corners at the ventro-lateral margins. The umbilicus is wide and its wall is steep.

The ribs, which are rather widely spaced, narrow, and subacutely crested, arise at the umbilical margin. Bifurcation may occur only once on a side, but the anterior of the two branches of a given rib may bifurcate again a short distance farther outward. The anterior of these three branches may, after crossing the venter, terminate just beyond the ventro-lateral margin without uniting with the ribs on the other side. A few ribs are intercalated on the venter, terminating on both sides of it, and are thus completely detached from the primary ribs. There is some alternation of ribs (see fig. 1), all of them being uninterrupted and about equally spaced.

THE APTIAN SPECIES

FAMILY PULCHELLIDAE

GENUS KNEMICERAS J. BÖHM, 1898

Knemiceras bassleri n. sp.

PLATE XVII, Figures 1, 2

This species is created for one large individual which attained a rather stout whorl section before it reached a diameter of 6 cm. On the outer whorl the greatest thickness, which is about five-eighths of its height, is near the umbilicus. The same general form characterizes the next preceding whorl, but here the thickness is about four-fifths of the height. The

whorl at a diameter of 9 cm. is thus much more inflated than that of *Knemiceras semicostatum* at the same diameter. The sides converge outward from the greatest whorl-thickness to the rather broad truncated venter which, on the outer whorl, is about one-third as wide as the greatest thickness of the whorl. The venter is bordered on each side by subangular ridges bearing alternating nodes, which at this stage of growth have lost their sharpness and have become less elongated in the direction of coiling than is true of *Knemiceras* at the stages in which it is usually found. A second row of nodes, five in number on the outer whorl, and exceedingly broad at their bases, encircles the umbilical depression. The rather broad low rounded ribs, instead of forking near the middle of the flanks, radiate outward from these inner nodes in bundles of two or three and terminate externally in the ventro-lateral row of nodes.

The lobes and saddles are sinuous in outline. The first lateral saddle is broader than the others and is divided by a deep adventitious lobe within its middle. The second lateral saddle and the first and second auxiliary saddles are divided medially by indentations deeper than the other crenulations of these saddles. The central lobe flares backward and is divided medially into two slender arms pointing backward. The first lateral lobe is about as deep as the ventral lobe and is much incised. The second lateral lobe extends farther backward, but the first auxiliary is much shorter. The remaining auxiliaries decrease gradually in size toward the umbilicus.

THE MIDDLE ALBIAN SPECIES

FAMILY PULCHELLIDAE

GENUS KNEMICERAS J. BÖHM, 1898

The genus *Knemiceras* was proposed in 1898 by Böhm (4, p. 200) with *Ammonites syriacus* von Buch (10, pl. 5, figs. 1-3) as the genotype. Böhm stated that the new genus is characterized by three adventitious lobes, whereas *Engonoceras* and *Placenticeras*, the two genera with which it is most likely to be confused, have, respectively, four and two adventitious lobes. Sommermeier (63, pp.319-330) considered only one of the lobes of *Knemiceras* designated as adventitious by Böhm as of sufficient size to merit being called an adventitious lobe, and pointed out that, in any event, it is impossible to determine the number of adventitious lobes in many sutures. Hence, it is argued, the foregoing distinction fails as a means of separating the three genera in question. Sommermeier showed that in *Placenticeras* the suture is characterized by a lobe that is deeper than any

of the others, external to which are two lobes only slightly shorter. *Knemiceras*, on the other hand, was described as having a suture with two approximately equal, large lobes and one very much smaller, adventitious lobe.

Pervinquière (47, p. 201) did not recognize *Knemiceras* as a genus separate from *Engonoceras*, but pointed out that in the illustrations of sutures of *Engonoceras* given by Böhm and Hyatt (30) the two branches of the ventral lobe diverge widely and are directed toward the sides, whereas in *Knemiceras* they are approximately parallel and directed backward. This difference later formed the basis for separation of these two genera by Lisson (34) and by Sommermeier (63, p. 328).

Böhm (4, p. 197) stated that (translation) "the genus *Engonoceras* is, according to our present knowledge, an essentially American genus, and until the present time has been known only from the Texan Cretaceous province of distribution," but Spath (71) has since reported *Engonoceras* from the British Gault.

Knemiceras attenuatum (Hyatt) Krause (32, p. 8)

PLATE XVI, Figure 1

Knemiceras attenuatum (Hyatt) Hyatt, A., Pseudoceratites, 1903, p. 151, pl. 17, figs. 13-15.

Knemiceras aff. *attenuatum* Hyatt. Lisson, C. I., Ammonites del Peru, 1908, p. 3, pl. 3; Fossiles del Museo Raimondi, 1911, p. 3, pl. 3.

Knemiceras attenuatum-typicum. Sommermeier, L., Neues Jahrb., Beilage-Band. 30, 1910, pp. 341, 347, pl. 9, fig. 2.

The writer has assigned to this species half a dozen poorly preserved fragments and one specimen exhibiting a complete whorl but evidently crushed laterally.

The form is exceedingly compressed and involute. The whorl attains its greatest thickness on its inner third, whence the sides converge toward the very narrow, truncated venter. The sculpture consists of numerous very faint ribs radiating from the umbilicus to their terminations in two rows of small nodes, elongated in the direction of coiling, on the ventro-lateral ridges. Many of the ribs fork near the middle of the whorl; others are intercalated on the outer half.

The ventral lobe is displaced somewhat to the right of the median line of the venter and is terminated posteriorly by two backward-directed, slender arms, one on each side of the lobe. These arms are separated by a low subquadrate saddle. The first lateral saddle is broad and is divided just within its middle by a small adventitious lobe, and the two arms of the saddle thus formed are sinuous in outline. This small-scale sinuosity,

with many curves and few angles, characterizes most of the suture and is present in both lobes and saddles. The saddles are all more or less flattened at the top. The second lateral saddle is divided in the middle by a deep lobule. The first three auxiliary saddles are similar to it, but in the fourth the dividing lobule is reduced to the size of the other crenulations of the saddle. The fifth and last before the line of involution is reached is simple.

Knemiceras uhligi (Choffat) Krause (13, pp. 4, 77) (32, p. 9) is similar in being greatly compressed.

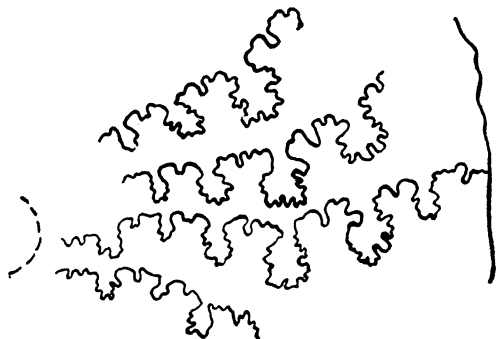


FIGURE 2. Suture of *Knemiceras attenuatum* Hyatt. Individual shown in Plate XVI, fig. 1. x2.

Knemiceras attenuatum (Hyatt) Krause var. *spinosa* Sommermeier

PLATE XVI, Figures 3, 4

Knemiceras attenuatum-typicum var. *spinosa* Sommermeier, L., Neues Jahrb., Beilage-Band 30, 1910, p. 347, pl. 9, fig. 2.

This variety appears to differ from the type only in possessing five or six small but conspicuous pointed tubercles at the umbilical shoulder.

Knemiceras semicostatum Sommermeier

PLATE XV, Figures 1, 2, 3

Knemiceras attenuatum-semicostatum Sommermeier, L., Neues Jahrb., Beilage-Band 30, 1910, p. 350, pl. 9, fig. 3; pl. 10, fig. 1.

To this species the writer has assigned a number of individuals of various sizes.

The greatest thickness of the whorl, which is a little more than half its height, is within the inner third of the whorl, whence the sides converge to the margins of the truncated venter. They round into the shallow

umbilicus without forming a well-marked shoulder. Low rounded ribs radiate outward from six or seven rather prominent nodes encircling the umbilicus and most of them bifurcate near the middle of the flank; others, though not numerous, are intercalated in the ventral half of the sides, dying out near the middle of the whorl. All are terminated externally by small alternate tubercles, elongated in the direction of coiling, on the ventro-lateral ridges.

Both the lobes and the saddles are irregular and crenulated in outline. The first lateral saddle is much broader than any of the others and is divided into two parts by an adventitious lobe just within the middle of the saddle. The other saddles are, in some specimens, rather regularly divided in the middle by lobules deeper than the neighboring crenulations; in some specimens no such division occurs and the saddles, though crenulated, are in general evenly rounded in outline. The lobes, except the ventral lobe, flare broadly backward. The ventral lobe is bounded laterally by almost parallel sides, and is divided medially by a rather low rounded saddle. Two terminal points, directed backward, are thus formed. As a rule the first lateral lobe extends a little farther backward than the ventral lobe and the second lateral lobe extends still farther backward. The first auxiliary and the remaining auxiliary lobes are much reduced in length. A notable characteristic of the suture is the slight backward convexity of the line joining the tops of all the saddles.

This species differs from *Knemiceras attenuatum* (Hyatt) Krause, described elsewhere in this paper, in having a stouter whorl with a broader venter.



FIGURE 3. Suture of *Knemiceras semicostatum* Sommermeier. Individual shown in Plate XV, fig. 3. $\times 1$.

Knemiceras crassicostatum Sommermeier

PLATE XVIII, Figures 1 and 2; PLATE XIX, Figures 1 and 2

? *Engonoceras* sp. (adulte) Douvillé, R., Annales de la Société Royale Zoologique et Malacologique de Belgique, v. 41, 1906, pl. 2, fig. 3.

Knemiceras attenuatum-crassicostatum Sommermeier. Neues Jahrb., Beilage-Band 30, 1910, pp. 343 and 355, pl. 10, fig. 4, pl. 11, fig. 1-3.

At a diameter of 5.8 cm. the whorl section is reminiscent of *Knemiceras semicostatum* at the same size. The whorl tapers outward from its greatest thickness near the umbilicus to the truncated venter. Half a whorl later in the animal's growth, this shape was supplanted by a subrectangular section with rounded corners. The thickness at this stage is about one-half the height. Also, a transition occurs in the same half-whorl in the arrangement of the ventro-lateral tubercles, which up to this stage alternate on the sides of the venter but become opposite from this stage forward, as in the example figured by Douvillé. Some specimens have a small number of nodes in a row that encircles the umbilicus; in others such nodes are absent. None of the writer's specimens show clearly definable nodes farther out on the flanks. The ribs are strong but in the present collection they are not so prominent as is indicated by Sommermeier's descriptions and figures. Some of them extend from the indefinite, rounded umbilical shoulder outward to the margin of the truncated venter, and may be forked on the sides of the whorl. Others are intercalated and do not reach the umbilical shoulder. The suture is poorly preserved on all the specimens examined.

Knemiceras crassinodosum Sommermeier

PLATE XVI, Figure 2; PLATE XX, Figures 1, 2

Engonoceras stolleyi Böhm. Douvillé, R., Annales de la Société Royale Zoologique et Malacologique de Belgique, v. 41, 1906, p. 153, pl. 3, fig. 2.

? *Engonoceras pierdenale* Lisson, C. I., Ammonites del Perú, 1908, p. 5, pl. 5; Fossiles del Museo Raimondi, 1911, p. 5, pl. 5.

Knemiceras attenuatum-crassinodosum Sommermeier, L., Neues Jahrb., Beilage-Band 30, 1910, pp. 345 and 361, pl. 13, figs. 1-2.

The greatest thickness, which is about two-thirds of the height of the whorl, occurs near the umbilicus, whence the sides converge to the truncated venter, whose width is about one-third of the greatest thickness of the whorl. The sides round over into the umbilicus, thus forming a poorly defined umbilical shoulder. Three rows of nodes occur on each side. Those

of the inner-most row, encircling the umbilicus, number about six on the outer whorl. The outermost nodes, on the ventro-lateral margin, are numerous, sharp, and elongated in the direction of coiling. Those of the third row, on the outer third of the flanks, are less prominent than the nodes of the other two rows. They are about twice as numerous as the inner-most nodes.

The ventral lobe of the suture is bounded by almost parallel sides, is divided medially by a subquadrate saddle, and terminates in two backward-directed, slender arms. The first lateral saddle is much broader than the others and is indented by an adventitious lobe within its middle as well as by minor crenulations on its outer portion. The remaining saddles that are visible in the material in hand are simple in outline but are divided medially by deep incisions into rounded halves. The first and second lateral lobes are about equal in length and are longer than the other lobes. All of the lobes flare backward and are sinuous in outline.

Knemiceras sommermeieri n. sp.

PLATE XVIII, Figures 5, 6

This species is similar in most respects to *Knemiceras semicostatum* Sommermeier, from which it differs chiefly in the simpler outline of the saddles of the suture. These, instead of being much crenulated, are evenly rounded except for two indentations in the first lateral saddle and one each in the second lateral and first auxiliary saddles.

The greatest thickness is near the umbilicus, whence the sides converge outward to the ventro-lateral ridges bounding the truncated venter. On the right side of the single specimen in hand, where the shell is not preserved, 7 or 8 low nodelike swellings encircle the umbilicus; on the left side these are matched by small but conspicuous pointed tubercles belonging to the shell. The ribs radiate outward from these processes or are intercalated on the outer third of the sides and all are bent slightly forward. The ventro-lateral ridges each bear a row of alternate, small, sharp, lengthwise-elongated tubercles forming the external terminations of the ribs.

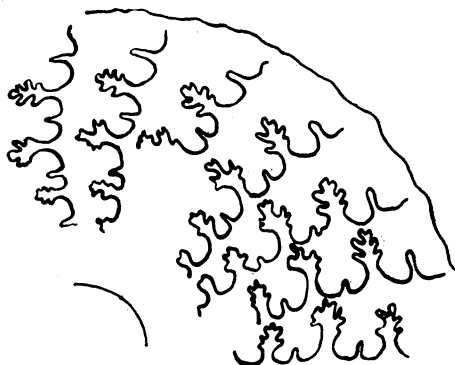


FIGURE 4. Suture of *Knemiceras sommermeieri* n. sp. Individual shown in Plate XVIII, figs. 5, 6. $\times 2$.

Knemiceras raimondi Lisson

PLATE XIX, Figures 3 and 4; PLATE XX, Figure 3

Knemiceras raimondi Lisson, C. I., Ammonites del Perú, 1908, p. 4, pl. 4; Fossiles del Museo Raimondi, 1911, p. 4, pl. 4.

Knemiceras attenuatum-raimondi Sommermeier, L., Neues Jahrb., Beilage-Band 30, 1910, pp. 346 and 363, pl. 13, figs. 3-7; pl. 14, figs. 1-3.

The adult whorl is subrectangular in cross section; the thickness is about five-sevenths of the height of the whorl and very little more than the width of the venter. As in *Knemiceras crassinodosum* there are three rows of nodes. Those of the external row occur in opposite pairs on the margins of the venter. When the margins are followed backward, however, it is seen that the nodes tend to alternate, and it is quite probable that they are thus disposed on the next preceding whorl. Probably seven nodes form the inner row which encircles the umbilicus. The intermediate row is a little more than half-way between the inner row and the ventro-lateral margin. Inconspicuous radial ribs, which are difficult to trace, traverse the sides, connecting the nodes of the three rows.

The sutures are not well preserved in the material in hand, but the two slender, backward-pointing arms of the ventral lobe can be clearly distinguished, as can also the broad first lateral saddle. Enough can be seen of the remaining lobes and saddles to reveal their distinctly knemiceratid character.

Knemiceras moorei n. sp.

PLATE XXI, Figures 1 and 2

The greatest thickness of the whorl, which is about five-eighths of its height, occurs in its inner third, whence the sides curve into the umbilicus without forming a definite umbilical shoulder, and converge convexly to the margins of the truncated venter. The venter is about one-third as wide as the greatest thickness of the whorl. The only nodes are those of the ventro-lateral margins, which are numerous, sharp, only slightly elongated in the direction of coiling, and arranged alternately on the two ridges. The ribs, which arise near the umbilicus or through forking or intercalation on the sides, are so inconspicuous that the sides appear at first sight to be smooth.

The ventral lobe flares slightly backward and is divided medially by a minor saddle. The first lateral saddle is very broad and is divided by a deep lobule in its inner half and by small notches on each side of this lobule. The second lateral saddle is notched three times, the middle notch being the deepest. The first and second auxiliary saddles are each divided into rounded halves by a notch in the middle. The third and fourth auxiliaries are each notched more than once; the fifth and sixth are simple.

The shape of the whorls is somewhat similar to that of *Knemiceras semicostatum*, though the nodes seen at the umbilical shoulder in that species here are absent and the ribbing is very much less pronounced.

Knemiceras sp.

PLATE XXII, Figures 1a, 1b

Knemiceras (adulte) Douvillé, R., Annales de la Société Royale Zoologique et Malacologique de Belgique, v. 41, 1906, p. 151, pl. 4, fig. 1.

One large, poorly preserved half-whorl specimen in hand greatly resembles the "adulte" example figured by Douvillé. It attains its greatest thickness, which is approximately four-fifths of the whorl-height, about midway between the umbilicus and the venter. Alternating low rounded nodes are present on each side of the truncated venter. A few widely spaced ribs are seen, and two processes, one of them much more protuberant than the other, occur about one-fifth of the whorl apart. These are in the nature of radial ribs terminating externally in a nodelike prominence on the outer third of the whorl and internally in a similar protuberance on the inner third. A row of radially elongated nodes coincides in position with the external termination of these processes.

FAMILY ACANTHOCERATIDAE

GENUS LYELLICERAS SPATH, 1921

The genus *Lyelliceras* was proposed by Spath (67, p. 220) (69, p. 128) who cited as genotype figures 1 and 2 in d'Orbigny's (42, pl. 74, figs. 1, 2) illustration of *Ammonites lyelli* Deshayes in Leymerie, but later substituted d'Orbigny's figure 4. D'Orbigny's figures 1 and 2 (a and b in Spath's reproduction) illustrate a specimen in which the nodes of the median ventral row are more numerous than those of any of the other rows and are connected with the nodes of the ventro-lateral row by ribs which zigzag across the venter. Figures 3 and 4 of the same plate (c and d of Spath) depict a specimen in which a transition is seen from an earlier stage, having the same number of nodes in all rows, those of the three ventral rows being borne on ribs passing transversely across the venter, to a later stage in which the ventral ornamentation is like that of d'Orbigny's figures 1 and 2.

Acanthoceras pseudo-lyelli Parona and Bonarelli (44, pp. 98, 99, pl. 14, figs. 1, 2) is characterized by the ornamentation seen in d'Orbigny's figures 1 and 2, cited together with figure 3, when this species was created.

Ammonites lyelli Deshayes in Leymerie (33, pl. 17, fig. 16), long considered the type of the species *lyelli*, is transversely ribbed on the venter in the small specimen figured by Leymerie. Parona and Bonarelli considered that this condition is not necessarily a function of the small size. This opinion is also held by Spath (70, pt. 8, p. 320) and is confirmed by the figured specimen of *Lyelliceras ulrichi* n. sp., which is 110 mm. in diameter.

A specimen of *Lyelliceras* with a diameter of 110 mm. from Simiti, Colombia, in the United States National Museum, Washington, D. C., is ornamented in very much the same way as *Lyelliceras pseudo-lyelli* Parona and Bonarelli, and exhibits seven rows of nodes. All the examples of *Lyelliceras* from South America heretofore described, so far as the writer is aware, lack nodes at the umbilical shoulders, and some lack lateral nodes also, the number of rows being thus reduced to five or three.

Lyelliceras ulrichi, n. sp.

PLATE XXIII, Figures 1a, 1b

Acanthoceras prorsocurvatum Gerhardt. Douvillé, R., Annales de la Société Royale Zoologique et Malacologique de Belgique, v. 41, 1906, p. 144, pl. 2, fig. 1; not Gerhardt, K., Neues Jahrb., Beilage-Band 11, 1897, p. 168, pl. 4, fig. 8.

? *Prionotrophis radenaci* Pervinqui re. Sommermeier, L., Neues Jahrb., Beilage-Band 30, 1910, p. 380, pl. 15, fig. 3; not Pervinqui re, L.  tude Pal. Tun., 1907, p. 251, pl. 12, fig. 4.

Acanthoceras lyelli Leymerie. Neumann, R., Neues Jahrb., Beilage-Band 24, 1907, p. 93.

? *Acanthoceras lyelli* Leymerie. Schlagintweit, O., Neues Jahrb., Beilage-Band 33, 1911, p. 88. (Specimens I, III, and IV only.)

The whorls are subovate in cross section with their greatest thickness, about five-sixths of the whorl height, approximately midway between the umbilicus and the venter. The umbilicus is broad. On the outer whorl of the large figured specimen 30 strong ribs are present. These arise near the umbilicus, radiate in straight lines, and continue uninterruptedly across the venter. At the median line of the venter each rib bears a tubercle, elongated in the direction of coiling. Another row of tubercles appears on the outer third of each side, but these are not elongated. A third row, the individuals elongated like those of the median ventral row, lies midway between the other two rows on each side of the venter. Thus there are five rows of tubercles in all. One specimen in hand has developed all five rows at a diameter of 18 mm., this feature constituting its chief difference from *Lyelliceras mathewsi* n. sp., which acquires this row at a diameter of 6 cm.

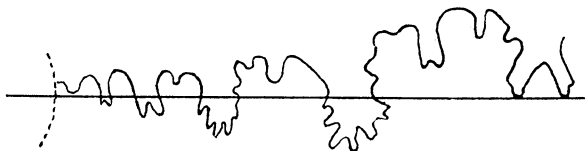


FIGURE 5. Suture of *Lyelliceras ulrichi* n. sp. Specimen in Collection 318. x3.

A small specimen in the collection exhibits a rather well preserved suture. The ventral lobe is divided medially by a saddle into two arms which diverge backward at an angle of about 50 degrees. The first lateral saddle is broad and divided just within its middle by a deep lobule. The outer arm thus formed is notched twice, while the inner arm is broadly crenulated. The second lateral saddle and the first auxiliary saddle are also divided medially by lobules, but the second and third auxiliaries are simple. The first and second lateral lobes each bear several denticles. Both the first and second auxiliary lobes are indented once in the middle.

Lyelliceras mathewsi n. sp.

PLATE XXI, Figures 3a, 3b, 3c

Acanthoceras lyelli Leymerie. Steinmann, G., Neues Jahrb., Jahrgang 1881, pt. 2, pl. 7, fig. 3.

At a diameter of about 8 mm. the whorl-section is subcircular. The sides bear strong ribs but these do not reach the venter, which is quite smooth. No tubercles have been developed at this stage. The umbilicus is broad. Two narrow lateral lobes and one auxiliary lobe are present. The ventral lobe is about as long as the first lateral lobe and is divided medially by a minor saddle. The first lateral saddle is already slightly crenulated and is very much broader than any of the other sutural elements. The second lateral saddle is notched once near the middle; the first auxiliary saddle is simple.

At a diameter of 2 cm. the whorl-section has become subovate. The thickness of the whorl is now about four-fifths of its height. The strongly developed ribs cross the venter uninterruptedly and bear a median row of rounded tubercles and, on each side of the venter, a row of tubercles elongated in the direction of coiling. Lateral tubercles have not yet appeared.

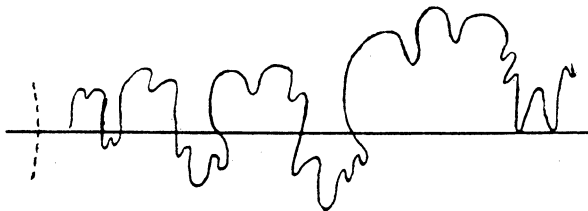


FIGURE 6. Suture of *Lyelliceras mathewsi* n. sp. Specimen in Collection 318. x3.

The suture at a diameter of $3\frac{1}{2}$ cm., illustrated in figure 3c, is characterized by broad saddles and long narrow lobes. The ventral lobe is divided into two arms. The broad first lateral saddle and the remaining lobes and saddles are sinuous in outline.

At a diameter of 6 cm. a row of tubercles makes its appearance rather suddenly on the outer third of the sides. The ribs arise at the umbilical shoulder, forming sharp-crested straight radial ridges as far as the subacutely-pointed lateral tubercles, beyond which they broaden and become rounded. The tubercles of the ventro-lateral rows and the median row are elongated in the direction of coiling. The spaces between the ribs

are occupied by rounded troughs both on the venter and on the sides. The cross section of the whorl is subovate, the longer axis being radial. The umbilical shoulder is well marked and the umbilical wall is steep.

Lyelliceras ulrichi, n. sp. develops lateral tubercles at a much earlier stage of growth. Schlagintweit's (56, p. 88) specimens II and V may be small examples of this species.

FAMILY PRIONOTROPIDAE

GENUS BRANCOCERAS STEINMANN, 1881

The genus *Brancoceras* was proposed in 1881 by Steinmann (75, p. 133) to receive the species *Brancoceras aegoceratoides*, created at the same time for a form from Huallanca, Ancachs, Peru. No genotype was named, but the species *Ammonites senequieri* d'Orbigny (42, p. 292, pl. 86, figs. 3-5) and *Ammonites varicosus* Sowerby (65, p. 472, pl. 451, figs. 4, 5) were cited as falling within the genus. *Ammonites senequieri* is characterized by simplification of suture and complete or almost complete loss of keel. In *Ammonites varicosus* the keel is well defined and the suture tends to be more complex.

Hyatt (28, p. 325) in 1883 proposed the name *Brancoceras* for a genus of Devonian-Carboniferous goniatites, and in 1900 Hyatt (29, p. 590) unaccountably failed to recognize the priority of Steinmann's usage of the term. He proposed the name *Hystatoceras* as a synonym for *Brancoceras* of Steinmann and named *Ammonites senequieri* d'Orbigny as genotype therefore. At the same time he proposed the genus *Hystero-ceras* with *Ammonites varicosus* Sowerby as genotype.

Spath (69, p. 99) in 1922 choose *Ammonites varicosus* as genotype for *Brancoceras*, but Stieler (78, p. 400) had already, in 1920, followed Hyatt in adopting *Ammonites senequieri* as genotype. Spath (70, pt. 3, p. 79) in a later publication, recognized the latter species as genotype for *Brancoceras*. The name *Hystatoceras* Hyatt must therefore be discarded in favor of *Brancoceras*, of which the genotype is *Brancoceras senequieri* (d'Orbigny) and the genus *Hystero-ceras* retains *Hystero-ceras varicosum* (Sowerby), originally cited by Hyatt, as genotype.

Brancoceras aegoceratoides Steinmann

PLATE XXI, Figures 4a, 4b, 4c

Brancoceras aegoceratoides Steinmann, G., Neues Jahrb., Jahrgang 1881, pt. 2, p. 133, pl. 7, fig. 2.

The whorl-section is subovate and the thickness of the whorl is about three-fourths of its height. The umbilicus is wide. The ribs, arising at the umbilical shoulder, are subacutely crested until they reach the venter, which they cross uninterruptedly, having become much broader and flattened. The spaces between the ribs are occupied by well rounded troughs. There is usually some forward flexing of the ribs external to the middle of the sides, this feature being rather pronounced in some specimens. As in Steinmann's material, there is no trace of a keel in any of the specimens in hand.

The sutures are not well preserved in any of the writer's specimens. The first lateral saddle, only a little broader than the second lateral saddle, is crenulated. Three auxiliary saddles and possibly a fourth can be discerned.

In form and ornamentation and the plan of the suture, the present examples agree very well with Steinmann's illustrations. There is also close agreement with the form figured by Quenstedt (52, pl. 17, fig. 3) as *Ammonites senequieri* d'Orbigny and doubtfully cited by Steinmann in the synonymy of *Brancoceras aegoceratoides*.

Brancoceras quenstedti n. sp.

PLATE XXI, Figures 5a, 5b

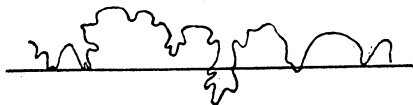


FIGURE 7. Suture of *Brancoceras quenstedti* n. sp. Specimen in U. S. National Museum Collection 11340. x4.

This species is created for a single specimen from the Pongo de Manseriche, Rio Marañon, in the United States National Museum, Washington, D. C. In form and ornamentation it appears to be identical with *Brancoceras aegoceratoides* Steinmann, but its suture differs greatly. The first lateral saddle is exceedingly broad and is in strong contrast to the first lateral lobe, which is long and slender. The saddle is divided into

two parts, of which the external is about twice as broad as the internal. The ventral lobe is divided into two arms which diverge backward at a small angle.

GENUS *MOJSISOVICSIA* STEINMANN, 1881

The genus *Mojsisovicsia* was proposed by Steinmann (75, p. 142) in 1881 with the species *dürfeldi* as genotype. Gabb (24, p. 273, pl. 39, fig. 2) had already in 1877 described an apparently identical form as the young, almost smooth stage of a type which later in life became strongly sculptured. He gave it the name *Ammonites ventanillensis*. Steinmann (76, p. 167) in 1882 expressed doubt that Gabb's interpretation was correct. Lisson (34, pls. 15, 16) and Douglas (18, p. 270, pl. 15, fig. 8) have removed all doubt by figuring specimens in which the transition from the smooth stage to the later ornamented stage is clearly seen. Thus, though the genotype must remain *Mojsisovicsia dürfeldi*, of which the adult stages are known only by inference, *Mojsisovicsia ventanillensis* (Gabb) spath (69, p. 97) (70, pt. 8, p. 352) may serve as the provisional type for the later stages.

Mojsisovicsia gabbi n. sp.

PLATE XXIII, Figures 2a, 2b

This species is based on a single fragment from the Pongo de Manseriche, Rio Marañon, in Collection 11340 of the U. S. National Museum, Washington, D. C.

The whorl is moderately depressed. The umbilicus is rather wide. At the umbilical margin arise numerous prominent ribs, the crests of which are subacute, whereas the troughs separating them are rounded. Their direction is about radial from the umbilical margin to the middle of the flanks, where they bend forward and rise near the ventral keel into pointed tubercles, thence continuing with strong forward inclination to the base of the keel. The keel is high, laterally compressed, and rounded on top. The distance between the two ventro-lateral rows of tubercles is a little less than half the greatest thickness of the whorl which, in turn, is a little more than the height, including the keel.

Mojsisovicsia ventanillensis (Gabb) Spath, as figured and described by Gabb (24, p. 273, pl. 39, fig. 2), has in the adult stage an additional row of tubercles on each flank, and the ribs bend even more strongly forward on the venter. The form, moreover, seems to be more compressed. Stein-

mann's *Mojsisovicsia dürfeldi* (75, p. 144) is inadequately described. Lisson's *Schloenbachia ventanillensis* (34, pp. 16-16c) has a higher whorl-section, lateral tubercles, and a wider separation of the two ventro-lateral rows of tubercles. Douglas (18, p. 270, pl. 17, fig. 4; pl. 15, fig. 8) says that in his forms the ribbing does not continue onto the venter beyond the ventro-lateral tubercles.

GENUS OXYTROPIDOCERAS STEILER 1920
(PSEUDOPHACOCERAS SPATH 1921)

The genus *Oxytropidoceras* was proposed by Stieler (78, p. 345), who named as genotype *Ammonites roissyanus* d'Orbigny (42, pl. 89). At the same time the genus *Inflatoceras* with genotype *Ammonites inflatus* Sowerby (65, pl. 178) (69, p. 101, text fig. A) was proposed for a large number of Gault forms which had for the most part been assigned to the genus *Mortoniceras*, then used by many authors to include both Albian and Senonian species. Böhm (5, p. 152), however, had proposed the genus *Pervinquieria* with the genotype *Ammonites inflatus* Sowerby, so that *Inflatoceras* had no validity. Recently Spath has proposed to restrict *Mortoniceras* to the Albian species allied to *A. vespertinum* Morton, which includes *A. inflata*. Thus both *Pervinquieria* and *Inflatoceras* become synonymous. Likewise, Spath's (67, p. 281) genus, *Pseudophacoceras* with genotype *Ammonites roissyanus* d'Orbigny, is antedated by *Oxytropidoceras* Stieler. Spath later proposed several new genera, including forms originally assigned by Stieler to *Oxytropidoceras*. These genera constitute in large part the family Dipoloceratidae of Spath (67, p. 281, pl. 25, fig. 1), including the genus *Manuaniceras*, with genotype *Pseudophacoceras manuanense* Spath, which is treated by the present writer as merely a subgenus of *Oxytropidoceras*.

Stieler (78, p. 347) makes the statement that in Europe *Oxytropidoceras* was later replaced by *Pervinquieria*, but that the situation is different in South America, where the *Oxytropidoceras* forms were more retarded in development and hence occur together with *Inflatoceras* (i. e., *Pervinquieria*) *inflatum*. He further states (78, pp. 392-393) that in South America a side branch of the main stem developed (of the *Oxytropidoceras*-*Inflatoceras* series) which throughout retained a resemblance to *Oxytropidoceras*, but with a development of ventral nodes like *Inflatoceras*. He considers that the occurrence of his *Oxytropidoceras karsteni*, described in the same paper, in the same block with a small *inflatum*, is positive proof that *Oxytropidoceras* ranges up into the *inflatus* zone in South

America. Spath (72, p. 182), however, created the genus *Venezoliceras* for the species *venezolense* Stieler which occurs together with *Karsteni* and, according to Stieler (78, p. 396), resembles it. Spath's views regarding Stieler's deductions are embodied in the statement that "there appears to be no doubt that *Inflatoceras inflatum* could not occur in the same block with '*Oxytropidoceras*' *karsteni* Stieler, probably a much earlier (Lower) Gault form. To identify a small individual definitely as *Inflatoceras inflatum* is in any case almost impossible, even with topotypes."

Oxytropidoceras douglasi n. sp.

PLATE XXIV, Figures 1, 2, 3, 4; PLATE XXV, Figures 1, 2; PLATE XXVI;
PLATE XXVII, Figures 2, 3; PLATE XXVIII, Figure 1

Schloenbachia cf. *roissyana* d'Orbigny. Douvillé, R., Annales de la Société Royale Zoologique et Malacologique de Belgique, v. 41, 1906, p. 147, pl. 4, fig. 3.

Schloenbachia aff. *belknapi* Marcou. Douvillé, A., Annales de la Société Royale Zoologique et Malacologique de Belgique, v. 41, 1906, p. 148, pl. 2, fig. 4.

Schloenbachia cf. *belknapi* Böse (Non Marcou). Douglas, J. A., Q. J. G. S. London, v. 77, 1921, p. 269, pl. 17, figs. 1; 2.

Schloenbachia cf. *chihuahuensis* Böse. Douglas, J. A., Q. J. G. E. London, v. 77, 1921, p. 269, pl. 17, fig. 3.

Nearly all the writer's specimens are fragmentary and in a state of preservation that renders any attempt at separation of species among them hazardous. It is believed, therefore, that it is better at present to group together in one species a large number of individuals which differ in minor degree among themselves, while calling attention to a few of the variations which, when better material is available, may necessitate differentiation of species.

The thickness of the whorl is somewhat variable, but is usually a little more than one-half its height. The maximum thickness usually occurs about one-third of the distance from the umbilicus to the venter. There is never any distinct demarcation between the sides and the ventral region, although commonly an increase in convexity occurs on the outer third of the sides, whence they are more or less flattened to near the umbilical shoulder. The umbilical wall is quite steep and the umbilicus generally occupies about one-fifth of the diameter of the shell. Numerous ribs, commonly narrower than the spaces between them and with their forward edges nearly always steeper than the back slopes, make a forward convex bend to the middle of the sides and thence a backward convex curve to the keel. The spacing of the ribs as well as the form of their surfaces varies considerably among individual specimens having the same height

of whorl. In general they are subacutely crested from the umbilicus to the outer third of the sides, where they become rounded and bulged. This bulging is sometimes quite pronounced.

The keel on a specimen with a whorl-height of about 7 cm. is approximately 8 mm. high and sharp. On the small individual figured the keel is unusually well preserved.

The septal suture is characterized by high, open, much frilled saddles and deep, much incised lobes. The first lateral saddle is always divided near the middle by a deep denticulated lobule. The first lateral lobe, which extends only slightly farther backward than the ventral lobe, is divided posteriorly into three slender denticulated arms. The middle arm is about twice as long as either of the other two. A second lateral lobe and two auxiliary lobes are also present.

Other occurrences which bear at least a superficial resemblance to *Oxytropidoceras douglasi* are *Oxytropidoceras mirapelianum* (d'Orbigny) Stieler (**43**, p. 124),* *O. chihuahuense* (Böse), (**6**, p. 73; pl. 5, figs. 3, 4; pl. 7, figs. 3, 4; pl. 8, figs. 1, 2), *O. cfr. belknapi* in Böse (**6**, p. 71; pl. 5, figs. 1, 3; pl. 6; pl. 7, figs. 1, 2, 5), *O. kiowana* Twenhofel (**82**, p. 89, pl. 9, fig. 1). Specimens of *O. belknapi* (Marcou) (**38**, p. 34, pl. 2, fig. 1) in the United States National Museum show a tendency to forking and intercalation of ribs, which are not seen on the Peruvian material, and *O. belknapi* has straight ribs rather than curved ribs as in *Oxytropidoceras douglasi*.

Oxytropidoceras (*Manuaniceras*) *carbonarium* (Gabb)

PLATE XXVII, Figure 4; PLATE XXVIII, Figure 2; PLATE XXIX

Ammonites carbonarius Gabb, W. M., Jour. Acad. Nat. Sci. Philadelphia, 2 Ser., v. 8, 1877, p. 269, pl. 38, fig. 2.

Schloenbachia acuto-carinata (Shum. sp.) Marcou var. *multifida* Steinmann, G., Neues Jahrb., Jahrgang 1881, pt. 2, p. 139, pl. 7, fig. 1.

Schloenbachia multifida Steinmann. Douglas, J. A., Q. J. G. S., London, v. 77, 1921, p. 267, pl. 16, figs. 2-5.

The greatest thickness of the much compressed shell is one-half the whorl-height and is well out on the flattened sides. The descent into the narrow umbilicus is rather steep, but near the umbilical shoulder the flanks show only slight convexity. On the outer third of the flanks there is an increase of the convexity, but at the keel they converge at an acute angle.

The ribs number about 70 on the external half of the outer whorl

* *Ammonites cristatus* Quenstedt, F. A., (**52**, pl. 17, fig. 1).

of the large figured specimen. They arise at the umbilical margin and bifurcate on the inner third of the sides. Their course is radial and almost straight to the outer third, where they bend strongly forward to their terminations at the ventral keel. Where the shell is preserved the ribs are much flattened and the spaces separating them are much narrower than the ribs themselves. This is true of most of the species examined, but at one place on the specimen figured on Plates XXVIII and XXIX the shell has been worn away, affording a view of the cast. Here the ribs and interspaces are about equal in width.

The siphuncle is oval in cross section, the long axis being radial. The suture is not preserved in any of the writer's material.

This species was established in 1877 by Gabb, who stated that the ribs are about equally as wide as the interspaces. His illustrations, however, show flattened ribs and much narrower interspaces. The writer suspects that Gabb's description refers to the cast, whereas his figured specimen retains the shell. The fact that the costation of the shell differs from that of the cast was clearly stated by Gerhardt (25, p. 195) with reference to a related form from Colombia which he identified with Steinmann's variety *multifida*. This point was later taken up by Douglas (18, p. 277) in dealing with material from Peru.

Marcou (38, p. 34, pl. 2, fig. 1) in 1858, figured two specimens which he identified with *Ammonites peruvianus* von Buch (9, p. 5, figs. 5-7). One of these (38, fig. 1) appears to be almost identical with von Buch's figured types. Spath (67, p. 283), however, having seen Marcou's original material in the British Museum and in the collections of the Geological Survey of Great Britain, states that von Buch's species is more closely costate. Marcou expressed the opinion that *Ammonites acuto-carinatus* Shumard (57, p. 209, pl. 3, fig. 1) is also identical. Shumard's illustration can not be used for identification, and later authors have accepted Marcou's figures and description as typical of the species *acuto-carinatus*.

Von Buch states that the ribs of *Ammonites peruvianus* are "slightly curved forward toward the back (venter), are elevated, and much narrower than the intervals that separate them." Schlagintweit (56, p. 71) redescribed the species from the original material as "casts with unforked narrow ribs which increase in size very slowly toward the venter and are only slightly bent in S-fashion. The ribs, however, are somewhat weathered and the venter is not intact; the ribs must have been more enlarged and flexed in their external parts which are not preserved. That the ribs are considerably narrower than the interspaces is true only of the internal half of the shell." From these translated descriptions it is clear that *Am-*

monites peruvianus is quite distinct from both *Ammonites acuto-carinatus* Shumard in Marcou and *Ammonites carbonarius* Gabb and strongly suggests *Oxytropidoceras douglasi* n. sp., herein described. The latter impression is strengthened by the similarity of the whorl section in von Buch's figure 7 to that of *Oxytropidoceras douglasi*.

Marcou's figures for *Ammonites acuto-carinatus* depict flattened ribs with narrow interspaces and are thus somewhat similar to the shell of *Ammonites carbonarius*. The umbilicus, however, is represented as much wider than that of the latter species, and there is less tendency to forking of the ribs.

Oxytropidoceras (Manuaniceras) bösei n. sp.

PLATE XXVII, Figure 1

Schloenbachia sp. (cf. *acutocarinata* Böse non Shumard), Douglas, J. A., Q. J. G. S. London, v. 77, 1921, p. 269, pl. 16, fig. 1.

A few fragmental casts and two small complete whorls in the present collection belong to this species. The whorl-section is practically identical with that of *Oxytropidoceras carbonarium* (Gabb), herein described. The ribs, however, are only a little more than half as numerous as in that species, are only occasionally bifurcated on the inner third of the sides, and have a steep anterior edge but a more or less rounded posterial slope. The interspaces are about as wide as the ribs. The backward sweep of the ribs at the margin of the umbilical wall, described by Douglas, could not be observed on the specimens at hand. The ribs, however, are strongly flexed forward on the outer third of the whorl. The keel and the sutures are very poorly preserved.

Oxytropidoceras (Manuaniceras) hubbardi n. sp.

PLATE XXVIII, Figure 3

The greatest thickness of the shell is about half the whorl-height. An increase in convexity of the rather flat sides near the keel demarcates the ventral region. The ribs are more numerous than those of *Oxytropidoceras (Manuaniceras) carbonarium* and *Oxytropidoceras (Manuaniceras) bösei*. Most of them bifurcate on the inner third of the sides, and a few are intercalated externally that do not reach the umbilical shoulder. Near the narrow umbilicus the ribs are about radial, but at about one-third of their length outward from the umbilicus they bend forward for a short distance

before resuming their radial direction. In the ventral region they again bend forward in a broad arc to their terminations at the keel.

FAMILY COSMOCERATIDAE

GENUS DOUVILLÉICERAS GROSSOUVRE, 1893

Douvilléiceras sp.

PLATE XXX, Figures 1, 2

A large, poorly preserved quarter-whorl cast is assigned by the writer to the genus *Douvilléiceras*. The form is evolute and the whorl is depressed and well rounded in the ventral region. Numerous rounded ribs arise near the umbilicus and pass uninterruptedly across the venter. The presence of tubercles on the ribs is suspected but can not be definitely determined owing to the poor state of preservation.

The occurrence of this genus in Peru has heretofore been known from the works of Douvillé (21, p. 145) and Commermeier (63, p. 376).

THE SENONIAN SPECIES

FAMILY PULCHELLIDAE

GENUS TISSOTIA DOUVILLÉ, 1890

The genus *Tissotia* was proposed in 1890 by Douvillé (19, p. 285) with *Buchiceras tissoti* Bayle (2, pl. 40, fig. 1) as genotype. Douvillé (20, p. 501, fig. 1) in 1891 redescribed this species, figured it, and assigned to the genus *Tissotia* the species *ewaldi*, *fourneli*, and *robini*. He pointed out, the dissimilarity of the four species named to the type of the genus *Buchiceras* Hyatt (27a, p. 369), *Buchiceras bilobatum* (19, pp. 283-284, fig. 11) (30, p. 27, pl. 1, figs. 4-9), and contended that Neumayr and Uhlig (40) were not justified in associating them with *Buchiceras*. The sutures of the four species were characterized by Douvillé in general terms as follows (translation):

"The saddles number three or four, are broad and rounded, not indented, and the first or external saddle is always divided by a secondary lobule; the lobes are rather narrow and slightly enlarged at their posterior extremities, which are denticulated."

Later in the discussion he specifies the median keel.

Peron (46), in 1896, divided Douvillé's genus, making minor differences in the suture the chief basis for separating from *Tissotia* two new

Senonian genera, *Hemitissotia* and *Plesiotissotia*. This procedure he states (translation) was adopted "in order to maintain the genus *Tissotia* within the limits of the precise definition given to it by Douvillé." The writer's view is that such a position is untenable, for reasons presently to be stated. At the same time Peron proposed two other genera, *Pseudotissotia* and *Heterotissotia*. *Pseudotissotia* occurs in Turonian beds and *Heterotissotia*, though Senonian, has a truncated venter and lacks a median keel.

Hyatt (30, pp. 34-35) accepted Peron's genera and proposed four. Of these, *Choffaticeras* is, like *Pseudotissotia*, a Turonian form, but *Subtissotia*, *Metatissotia*, and *Paratissotia*, which are based on ontogeny alone, are Senonian.

Comparison of the sutures of *Tissotia* in the literature and in the collection in hand, numbering over 80 examples, reveals much variation within each species in the minor details of the lobes and saddles. Quite commonly these minor details differ on opposite sides of the same individual, as will be seen in several of the sutures of *Tissotia* herein illustrated (17a, p. 568). (70, pt. 1, pp. 6, 11). Moreover, indentations in saddles as simple as those of the sutures of *Tissotia* are conspicuous and are likely to receive more attention than details of no less magnitude in such complicated saddles as those of the sutures of *Oxytropidoceras*, for example.

These considerations have convinced the writer that Peron's genera *Hemitissotian* and *Plesiotissotia*, both accepted by Hyatt, are based on extremely variable and probably negligible differences in the suture—no greater than the differences in the sutures on opposite sides of *Tissotia stephensoni*, n. sp., as here reproduced in Figure 1. Hyatt's families, *Pseudotissotiidae* and *Tissotiidae*, are, in part, at least, based upon similar variations in the suture, which is remarkable in view of his observation that "the definitions heretofore given of this genus (*Tissotia*) have been based upon the sutures, which, according to the views here advanced, can not be accepted when not correlatable with external characters" (30, p. 42).

It must be apparent from what has been said that Douvillé's definition of *Tissotia*, as quoted above, should be modified to permit some indentation of the saddles and also with reference to the number of saddles, which may be as many as six. The basic plan of sutures, however, is rather constant within the genus *Tissotia*, and is regarded by the writer as the most important character warranting its separation from other genera.

Differences between the sutures of the opposite sides of individuals are common among ammonites (4, p. 194) (30, pl. 21, fig. 1) (32, p. 10) (41, p. 33). (61, pp. 80-81, figs. 20, 21) (37, p. 61). Solger correlates this phenomenon with a crawling benthonic habit and he regards *Tissotia* as

the possible forerunner of the Maestrichtian genus *Sphenodiscus*.

Solger (62, pp. 196-197), after a careful investigation of the distribution of the genus *Tissotia*, reached the conclusion that it is confined to beds of Coniacian (Lower Senonian) age.

Tissotia reesideana n. sp.

PLATE XXXI and PLATE XXXII, Figure 1

This is a moderately compressed, ventrally fastigate ammonite, the height of which in the adult is about twice its thickness. The umbilicus is narrow. The greatest thickness of the shell is not far from the umbilical shoulder, whence the sides converge very slightly toward the keel to about the middle of the flanks. The venter is bounded laterally by a rounded shoulder and the keel is flanked on each side by a shallow channel. The siphuncle exhibits an oval section, the long axis of which is radial. The lines of growth are almost radial except on the ventral channels, where they are deflected gently backward. The sides appear smooth, although faint radial costae may be detected by passing the finger along the flanks.

The form resembles that of *Tissotia ficheuri* de Grossouvre as figured by Peron (46, pl. 12, fig. 2), but that species is heterogeneous, for Grossouvre (26, p. 35) included in its synonymy a number of widely different forms. Peron's illustration shows more distinct ribbing than is seen in *Tissotia reesideana*. The present species may be identical with the form described as *Tissotia ficheuri* de Grossouvre by Paulcke, but Paulcke's (45, p. 277) description is inadequate. Brüggen's *Tissotia* cf. *auressensis* may also be identical (8, p. 723).

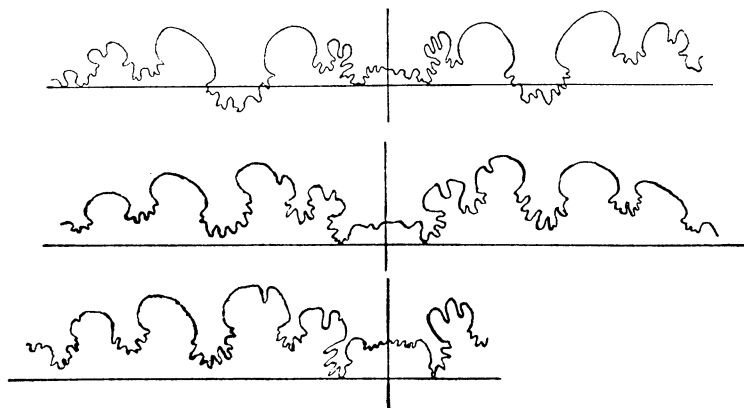


FIGURE 8. Suture of *Tissotia reesideana* n. sp. (a) suture of individual shown in Plates XXXI and XXXII, fig. 1. $\times \frac{1}{2}$; (b, c) sutures of two specimens from Collection 36, Rio Agua Blanca. $\times 1$.

The sutures of different specimens vary considerably with respect to minor details, as shown by figures 5, 6, and 7. Moreover, their outlines on opposite sides of the same specimen exhibit conspicuous differences, such as that of the outer arm of the first lateral saddle of the sutures illustrated in figures 5 and 7, in which two minor lobules occur on the right side of the specimen but only one minor lobule on the left side. The inner arm of the first lateral saddle is notched once in figures 6 and 7, but is entire on both sides of the specimen shown in figure 5. The second lateral saddle is entire in all the specimens, but the first auxiliary saddle is deeply indented in figure 5, has one small notch in figure 7, and is entire in figure 6. The lobes flare backward and always terminate in numerous denticulations; this is true also of the deep lobule that divides the first lateral saddle.

Tissotia steinmanni Lisson

PLATE XXXII, Figure 2 and PLATE XXXIII

Tissotia steinmanni Lisson, C. I., Ammonites del Perú, 1908, p. 1, pl. 1, fig. 1.

This is a compressed involute form, the whorl section being externally ogival, and has rather smooth sides. The greatest thickness, about five-twelfths of the whorl height in the adult, is a short distance out from the umbilical margin, whence the sides converge outward with slight convexity to the sharp keel of the cast. The fastigate venter and the laterally compressed form appeared early in the animal's growth. They may be observed in the figured specimen at a radius of about 15 millimeters.

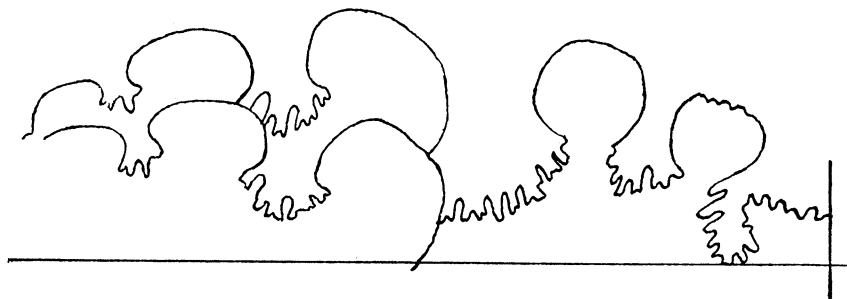


FIGURE 9. Suture of *Tissotia steinmanni* Lisson. Individual shown in Plate XXXII, fig. 2, and Plate XXXIII. $\times 1$.

The suture exhibits at least five rounded saddles, all of them entire except the broad first lateral saddle, which is divided unsymmetrically by a deep secondary lobule. The outer part is slightly crenulate and is about

two-thirds as broad as the inner part. The lobes are narrower than the saddles and terminate in numerous denticulations which are usually bifid, though they are occasionally simple or trifid.

In *Tissotia latelobata* Solger (62, p. 159), from the Cameroons, the keel is flanked by narrow channels that are absent in *Tissotia steinmanni*. *Tissotia regularis* (Hyatt) Lisson* is much more inflated.

Tissotia singewaldi n. sp.

PLATE XXXIV, Figures 3a, 3b

Tissotia fourneli (Bayle) Grossouvre. Neumann, R., Neues Jahrb. Beilage-Band 24, 1907, p. 123, pl. 5, fig. 4.

? *Tissotia* cf. *ewaldi* (von Buch) Douvillé. Brüggén, H., Neues Jahrb., Beilage-Band 30, 1910, p. 725.

These ammonites are ventrally fastigate and moderately inflated and their thickness is about two-thirds of their height. The umbilicus is narrow. The median ventral ridge is flanked by smooth shallow channels external to the ornamentation. Near the umbilical shoulder are six more or less prominent nodes, from each of which a bundle of two or three ribs radiates. Each of these ribs, as well as an occasional intercalated shorter rib, terminates in a basally rounded node at the margin of the smooth ventral channel. Fifteen external nodes, and hence 15 ribs, are visible on the type specimen. The writer recognizes within the species considerable variation in the strength of the ornamentation, with a series of gradations from strongly nodose and costate individuals to others that are almost smooth. The ornamentation of the living chamber, which is partially preserved in some specimens, is weak in comparison with that of the septate part of the shell. The lines of growth are radial except for a slight backward inflection on the smooth ventral channels.

A specimen from LaQuinua, Peru, as described and illustrated by Neumann, seems to be identical with the present species. Neumann identified the form with *Tissotia fourneli* (Bayle emend Thomas and Peron) de Grossouvre from Algeria (46, p. 59, pl. 10, figs. 1-8; pl. 17, figs. 9, 10), but the writer is of the opinion that it is safer to use separate specific names for examples from regions as far apart as Peru and Algeria. *Tissotia* cf. *ewaldi* (von Buch). Douvillé, as briefly described by Brüggén, may also be identical with *T. singewaldi*.

* *Paratissotia regularis* Hyatt, (30, p. 53, pl. 3).

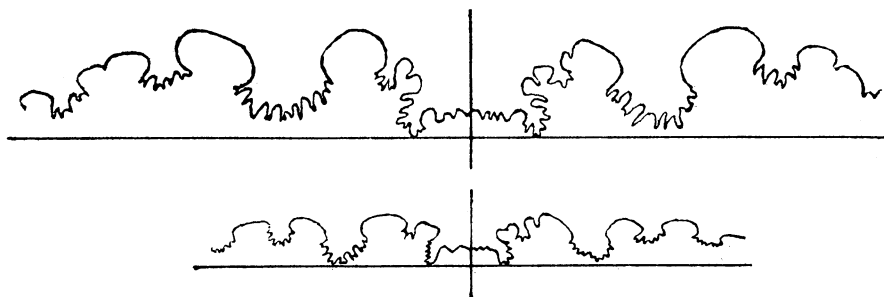


FIGURE 10. Suture of *Tissozia singewaldi* n. sp. (a) individual shown in Plate XXXIII, figs. 3a, 3b; (b) specimen from Collection 35, Rio Cuxiabatay. XI.

Minor differences between individuals and between the sutures of opposite sides of the same specimen are common in this species, as in the sutures shown in figures 9 and 10. The first lateral saddle is always divided by a deep lobule. In figures 9 and 10 each arm of the saddle is notched once on the right side of the median line of the suture; on the left side, in figure 9, only the outer arm of the saddle is notched. The second lateral saddle is apparently always entire. The first auxiliary saddle is notched once on each side of figure 9 but is entire on both sides of figure 10. Less conspicuous differences, such as that of the halves of the ventral saddle in figure 10, will be noted.

Tissozia walteri n. sp.

PLATE XVIII, Figures 3, 4

The greatest thickness of the shell, which is near the umbilical shoulder, is about three-quarters of the height of the whorl. The venter is separated from the sides by a distinct ventro-lateral ridge bearing a row of prominent tubercles elongated in the direction of coiling. From each of the tubercles in a second row at the umbilical shoulder, low rounded ribs radiate singly or in pairs, terminating in the tubercles of the external row. In the fragmentary specimen upon which the species is based, the ribs are less numerous than in *Tissozia singewaldi* n. sp. They probably number about 11 in the adult outer whorl. Greater stoutness of whorls and elongation of the external tubercles further differentiate this species from *Tissozia singewaldi*.

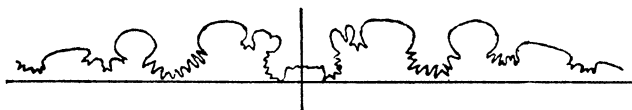


FIGURE 11. Suture of *Tissotia waltheri* n. sp. individual shown in Plate XVIII, figs. 3, 4. $\times 1$.

The suture of the single example of this species in hand is shown in figure 11. Its most striking characteristic, aside from those which may be termed generic, is the difference in the depth of the single indentation dividing the external arm of the first lateral saddle on the opposite sides of the specimen. The second lateral saddle and the auxiliaries are entire on both sides. The lobes flare backward and are all multidenticulate. Minor differences in denticulation may be noted in the corresponding lobes of the opposite sides of the shell.

Tissotia andii n. sp.

PLATES XXXV and XXXVI

This species is characterized by a whorl section whose greatest thickness is about equal to the height of the whorl and is about one-third of the distance out from the umbilicus. The sides are smooth and convexly rounded from the umbilical shoulder nearly to the median ventral ridge, which is flanked on each side by a shallow channel. The umbilicus is narrow.

The sides are not flat as in *Tissotia reesideana* n. sp., and the outer part of the flank is more convex than in *Tissotia roscheni* n. sp.

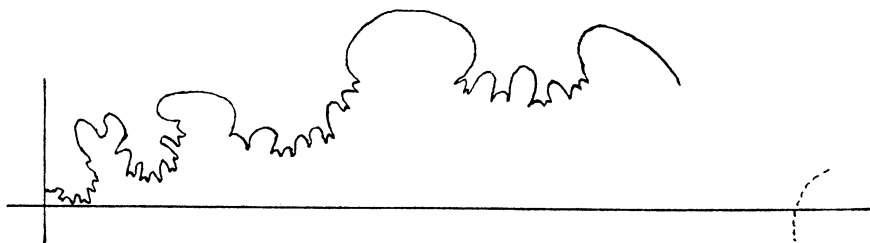


FIGURE 12. Suture of *Tissotia andii* n. sp. Specimen from Collection 31, Rio Saraya-quillo. $\times 1$.

The suture is well preserved on only one specimen. In this specimen the external saddle is divided by an unusually large secondary lobule. The

external arm of the saddle thus divided is notched once. The second lateral saddle and the first auxiliary are entire. The lobes and the dividing lobule of the first lateral saddle are all multidenticulate.

Tissotia stephensoni n. sp.

PLATE XXXVII, Figures 3, 4, 5

The thickness of the whorl is about two-thirds of its height, the thickest part being near the umbilical shoulder, whence the sides curve convexly toward two shallow channels that flank the sharp median ventral ridge. There is no marked distinction between the venter and the sides of the shell. The umbilicus is narrow. The umbilical shoulder bears a row of nodes from which ribs, low and rounded in cross section, spread outward in bundles of two or three and terminate near the median ventral ridge without forming nodes.

The form is similar to that of *Tissotia fischeuri* de Grossouvre as figured by Peron (46, pl. 12, fig. 2), one of a number of forms that differ widely among themselves in shape of whorl and in ornamentation but are similar in suture and therefore are included by Grossouvre in a single species. The present species differs from the example figured by Peron chiefly in ornamentation. His specimen lacks the umbilical row of nodes and is characterized by more widely spaced costae. *Tissotia reesideana* n. sp. is also similar, but its ornamentation is greatly suppressed.

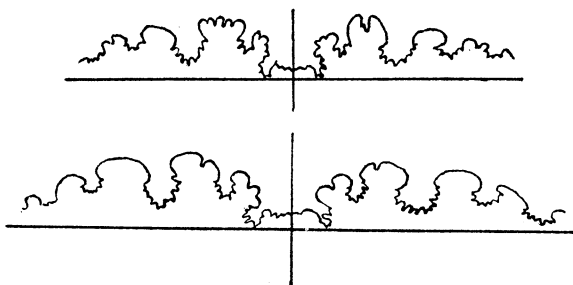


FIGURE 13. Suture of *Tissotia stephensoni* n. sp. (a) individual shown in Plate XXXVII, figs. 3, 4, 5; (b) specimen from Collection 37, Rio Agua Blanca. XI.

The suture of the figured specimen as reproduced in figure 13 is interesting in that the first lateral saddle is strikingly different on opposite sides of the specimen. The inner arm of this saddle is indented four times

on the left side, but only once on the right side. In figure 14 the inner arm is essentially the same on the opposite sides of the shell, but the outer arm is divided once on the right side and twice on the left side. On both specimens the second lateral saddle is entire on both sides, but the first auxiliary saddle, though it is entire in figure 14, is notched once on each side in figure 13. The lobes flare backward and all are multidenticulate.

Tissotia roscheni n. sp.

PLATE XXXVIII, Figures 1, 2

The greatest thickness, which is about three-quarters of the height of the whorl, occurs near the umbilicus, whence the sides converge with slight convexity to the median ventral ridge. The umbilicus is narrow. The sides are unornamented.

The suture is well preserved in only one specimen, a large one, in this collection. The dividing lobule of the first lateral saddle is large and terminates in numerous denticulations. The outer arm of the saddle is deeply indented; the inner arm is entire and subcircular in outline. The second lateral saddle and the first auxiliary saddle are entire and rounded. The lobes flare backward and all are multidenticulate.

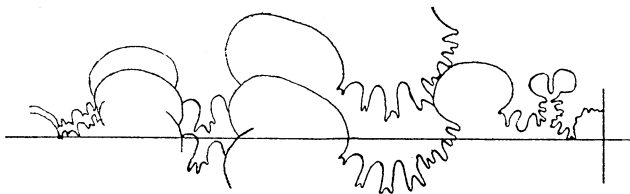


FIGURE 14. Suture of *Tissotia roscheni* n. sp. Specimen from Collection 31, Rio Sarayaquillo. xi.

The faintly costate and flattened sides of *Tissotia reesideana* n. sp. differentiate it from *Tissotia roscheni*.

Tissotia compressa n. sp.

PLATE XXXVII, Figures 6, 7

This is a compressed, involute form, the thickness of the adult whorl being about one-half its height. The thickest part of the whorl is near the middle of the flanks, whence the flanks converge gently inward to the steep umbilical wall and gently outward to the margin of the venter. The

cast possesses a well-defined median ventral ridge from an early ontogenetic stage until a radius of about 15 millimeters is reached, after which the ridge is low and blunt for a short distance before the venter becomes quite rounded. No trace of the ridge remains on the living-chamber. The ribs are simple or bifurcated or may be intercalated externally. They usually bend slightly forward from the umbilicus to about the middle of the flank, where they attain their greatest relief; thence they bend gently backward, become broad and low, and terminate ventrally without forming nodes.

Tissotia serrata (Hyatt)* and the present species are somewhat similar in the adult form, but Hyatt's species appears to retain the median ventral ridge at a much later ontogenetic stage.

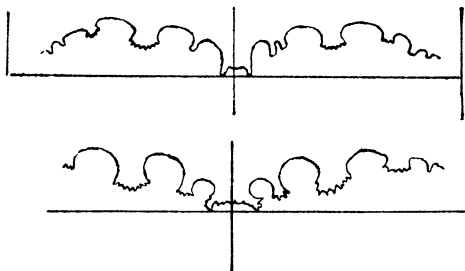


FIGURE 15. Suture of *Tissotia compressa* n. sp. (a) individual shown in Plate XXXVII, figs. 6, 7; (b) specimen from Collection 33, Rio Cuxiabaty. XI.

Differences in the details of the suture are frequently found among different specimens of *Tissotia compressa* and even on opposite sides of a single specimen. Thus the outer arm of the divided first lateral saddle is entire on the left side only in the suture reproduced in figure 16, but is indented on the right side. The dividing lobule of the first lateral saddle is a simple notch in figure 16, but is much larger in figure 17 and is denticulated at its posterior extremity. All the other saddles are entire. The lateral lobes are multidenticulate in the specimens in hand, but the auxiliary lobes are small and simple. The form of the ventral lobe also varies considerably.

* *Paratissotia serrata* Hyatt (30, p. 51, pl. 12, figs. 7-11).

Tissotia compressa n. sp. var. *levis* n. var.

PLATE XXXVII, Figure 2

A number of specimens in which the ornamentation is very much suppressed are referred by the writer to this variety. In all other respects they agree very well with the type.

Tissotia obesa n. sp.

PLATES XXXIX and XL

The greatest thickness of the shell, which is greater than the height of the whorl, is near the umbilical margin, whence the sides slope outward with slight convexity to the shallow ventral channels which flank the median ventral ridge on each side. The umbilicus is narrow. Ornamentation is absent.

Although the shell is exceedingly stout, as in *Tissotia inflata* Peron, Peron's (46, pl. 12, fig. 6) figured specimen has a more obtuse venter, which is separated from the sides by ventro-lateral ridges.

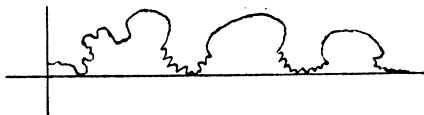


FIGURE 16. Suture of *Tissotia obesa* n. sp. Individual shown in Plates XXXIX and XL.

The suture is well preserved only on one side in the figured specimen. The outer arm of the divided first lateral saddle is indented once; the inner arm is entire. The second lateral saddle and the first auxiliary saddle are entire. The lobes are multidenticulate.

Tissotia halli n. sp.

PLATE XLI, Figures 1 and 5

The greatest thickness is about two-thirds of the height of the whorl. The umbilicus is narrow and the sides are about parallel and more or less flattened from the umbilical shoulder to the ventro-lateral margin. Broadly rounded ribs, wider than the spaces separating them, terminate in the ventral region after forming large rounded nodelike swellings at the ventro-lateral margin. Ten ribs are present on each side of the outer

whorl of the figured specimen. A sharp ridge marks the median line of the venter.

GENUS *HETEROTISSOTIA* PERON, 1897

Heterotissotia lissoni n. sp.

PLATE XXXIV, Figures 2a, 2b

Heterotissotia neoceratites Peron. Lüthy, J., Abhandl. d. Schweiz. Paläont. Ges., v. 43, 1918, p. 51, pl. 4, fig. 3. (other figures excluded.)

This is a moderately compressed form, the greatest thickness of the whorl being about four-fifths of its height. The distance across the truncated venter from one ventro-lateral ridge to the other is about half the greatest thickness of the whorl, which is just within the middle of the flanks. The umbilicus is quite narrow and the umbilical wall is rather steep. The sides converge outward with very slight convexity from the middle of the flanks to the ventro-lateral ridges. Very faint, low rounded ribs radiating from the umbilical shoulder may be detected. These ribs terminate at the ventro-lateral ridges in sharp tubercles, much elongated in the direction of coiling. The ventral surface is a shallow channel lying between these ridges. The cross section of the next preceding whorl is essentially the same as that of the whorl described.

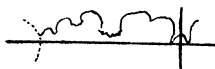


FIGURE 17. Suture of *Heterotissotia lissoni* n. sp. Individual shown in Plate XXXIV, figs. 2a, 2b. $\times 1$.

The ventral lobe is narrow and terminates in two simple arms directed backward. The first lateral lobe is denticulated, as is also the second lateral lobe, but the first lateral saddle is broad and is indented once near its center. The second lateral saddle and the two auxiliary saddles are simple and evenly rounded.

The whorl of this species is stouter than that of *Heterotissotia peroni* Lisson (34, p. 11, pl. 11) from the province of Cajamarca, Peru. The writer has not followed Lüthy in applying to this form from South America the specific name *neoceratites* Peron, originally assigned to an ammonite from Algeria (46, p. 82, pl. 16, figs. 9, 10; pl. 18, fig. 20). Such a procedure is regarded as inadvisable on account of the wide geographic separa-

tion of these two regions and because neither the illustrations by Lüthy nor the specimen in hand agree in all details with Peron's illustrations. The species *neoceratites*, according to Peron, occurs in Lower Senonian beds.

FAMILY PRIONOTROPIDAE

GENUS BARROISICERAS GROSSOUVRE, 1893

Barroisiceras grossouvrei n. sp.

PLATE XXXIV, Figures 1a, 1b

The whorl is stout, its greatest thickness being about equal to its height. The umbilicus is narrow. Prominent nodes, basally subcircular and probably five in number in the adult, occur at the umbilical shoulder, but only two are visible on the single half-whorl specimen in hand. Low rounded ribs radiate from the nodes in bundles of three, terminating at the ventro-lateral margin. The cast is thickest near the umbilical shoulder, whence the sides converge toward the two ridges forming the margins of the venter. The distance between these margins is a little more than half the maximum thickness of the whorl. The venter is essentially flat, but its center is raised a little to form a continuous keel and its surface on each side slopes at a low angle to the ventro-lateral ridges. The siphuncle is circular in section and lies directly under the low median ventral ridge.

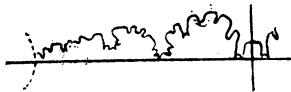


FIGURE 18. Suture of *Barroisiceras grossouvrei* n. sp. Individual shown in Plate XXXIV, figs. 1a, 1b. XI.

The ventral lobe is divided by a broad subquadrate saddle and terminates on each side of the median line in a long slender backward-directed arm. The first lateral saddle is broad and is indented several times. The second lateral saddle and the auxiliaries are also crenulated. The lobes are multidenticulate and much narrower than the saddles.

Reeside (53) proposed to exclude from the genus *Barroisiceras* forms comparable to this, having continuous keels, and cited *B. desmoulinsi* Grossouvre (26, p. 51, pl. 2, fig. 6) in particular, but Spath (74) insists that that species is a *Barroisiceras*.

Barroisiceras brüggeni n. sp.

PLATE XLI, Figures 2, 3, 4

The cast is moderately inflated and the maximum thickness of the whorl, about three-fourths of its height, occurs on the sides within a short distance of the very narrow umbilicus. The sides are evenly convex from the umbilicus to the ventro-lateral angles, and bear faint low rounded rather widely spaced ribs which terminate in tubercles elongated so as to form ridges at the ventro-lateral angles. The ventral area, thus separated from the sides by two rows of tubercles, is essentially flat and about half as wide as the greatest thickness of the whorl. The median line of the venter is marked by a low keel. Owing to the poor preservation of the single specimen in hand, it could not be ascertained whether the keel is continuous or divided into tubercles.

The poorly preserved suture has three or four lobes which are about as broad as the saddles. The saddles as well as the lobes appear to be crenulated.

The form described by Brüggén (8, p. 730) as *Barroisiceras habereffneri* (von Hauer) Grossouvre is more compressed, as is also that described and figured as var. *nicklèsi* of the same species by Boule, Lemoine,

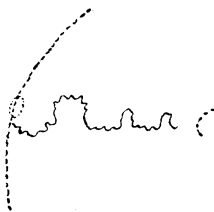


FIGURE 19. Suture of *Barroisiceras brüggeni* n. sp. Individual shown in Plate XLI, figs. 2, 3, 4. Ventral lobe unknown. XI.

and Thevenin (7, t. 2, f. 1, p. 35, pl. 4 (11), fig. 2). The latter, which occurs in Madagascar, is nevertheless very similar in general appearance to *Barroisiceras brüggeni*.

GENUS BUCHICERAS HYATT, 1875

Buchiceras bilobatum Hyatt emend. Brüggén

PLATE XLII

Buchiceras bilobatum Hyatt. Brüggén, H., Neues Jahrb., Beilage-Band 30, 1910, p. 727, pl. 28, figs. 1, 2.

Buchiceras bilobatum Hyatt. Lüthy, J., Abhandl. d. Schweiz. Palaeont. Ges., v. 43, 1918, p. 81, pl. 1, fig. 1.

The single specimen in hand is a poorly preserved cast from which the matrix, covering large areas, could not be removed owing to the fragile nature of the cast. A row of nodes occurs on each side near the narrow umbilicus. Broadly rounded ribs, distantly set, radiate from these nodes and terminate in additional exceedingly protuberant nodes, elongated in the direction of coiling, which together form a ridge separating the more or less flattened and broad venter from the flanks.

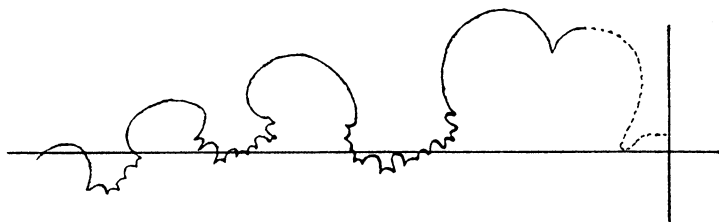


FIGURE 20. Suture of *Buchiceras bilobatum* Hyatt. Individual shown in Plate XLII.
x1.

The ventral lobe is not preserved. The broadly rounded first lateral saddle is notched at least once, but the remaining saddles are entire. The lobes, probably not more than five in number, flare backward and are multidenticulate.

Brüggen and Lüthy agree in including in the single species *Buchiceras bilobatum* all the species assigned by Hyatt (30, pp. 27-34) to the genera *Buchiceras* and *Roemeroceras*. In the absence of sufficient material upon which to base an opinion as to the validity of this procedure, and in view of the vagueness of Hyatt's descriptions, the writer has chosen to follow the two European authors in adopting a rather broad concept of this species.

GENUS EULOPHOCERAS HYATT, 1903

The genus *Eulophoceras* was proposed by Hyatt (30, p. 86, pl. 11, figs. 2-6) in 1903 to receive the species *Eulophoceras natalense* Hyatt from Natal, South Africa. So far as the writer is aware, the genus has not heretofore been reported from any other part of the world.

The genera *Pelecodiscus* van Hoepen (27, p. 30) and *Spheniscoceras* Spath (67, p. 242) (68, p. 142) also proposed for material from Africa,

are here regarded as synonymous with, and antedated by, Hyatt's genus. They occur in the Senonian of Pondoland.

Eulophoceras berryi n. sp.

PLATE XLIII, Figures 1 and 2

The form is compressed and the thickness of the whorl is about three-eighths of its height. The sides are smooth, rounded, and converge with slight convexity and at an acute angle from points near the narrow umbilicus to the median ventral ridge, which is extremely sharp even in the cast. The umbilical shoulder is rounded and the descent into the umbilicus is not steep. The lines of growth are radial near the umbilicus, make a broad arc, convex toward the aperture, and terminate at the ventral ridge after bending forward for about a quarter of an inch. The septa are somewhat closely set, the last two being more closely spaced than the others.



FIGURE 21. Suture of *Eulophoceras berryi* n. sp. Individual shown in Plate XLIII, figs. 1 and 2. $\times 1$.

The ventral lobe is quite broad but not very deep, and is divided by a broad subquadrate saddle. The first lateral saddle is broad and divided by a large multidenticulate lobule into two parts, each of which is divided by a deep medial indentation and several shallow notches. The second lateral saddle and the first auxiliary are much indented, but the remaining auxiliaries, of which there are at least five, are generally indented only once or twice and then not deeply. The first lateral lobe terminates posteriorly in two long slender arms, and the lobe is inclined toward the venter.

The suture and whorl-section of this form seem sufficiently like those of *Eulophoceras natalense* Hyatt (30, p. 86, pl. 11, figs. 2-6) to warrant assignment to the same genus.

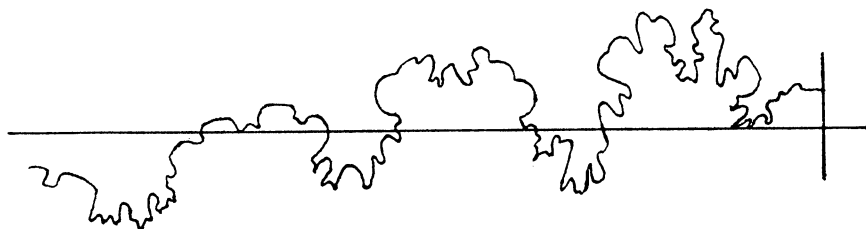
GENUS LENTICERAS GERHARDT, 1897

Lenticeras baltae Lisson

PLATE XXXVII, Figure 1; PLATE XLIV

Lenticeras baltae Lisson, C. I., Ammonites del Perú, 1908, pp. 14-14d.

The cast is moderately compressed and highly involute. The sides are smooth and converge convexly from the vicinity of the umbilicus to the fastigate venter.

FIGURE 22. Suture of *Lenticeras baltae* Lisson. Individual shown in Plate XLIV. xi.

The first lateral saddle is divided into three parts by deep lobules. The other saddles are somewhat irregularly indented. The first lateral lobe is essentially trifid, each of the arms being denticulated.

Lenticeras gerhardti n. sp.

PLATE XLV, Figures 1, 2

This is a moderately compressed, fastigate-ventered ammonite, the thickness of which is about five-eighths of its height. The greatest thickness occurs near the narrow umbilicus, and the sides converge to the median ventral ridge with an even convex curve. Faint, rather widely spaced ribs radiate from near the umbilical shoulder and terminate near the ventral ridge.

FIGURE 23. Suture of *Lenticeras gerhardti* n. sp. Individual shown in Plate XLV, figs. 1, 2. xi.

The first lateral saddle is divided into three parts by deep lobules. The remaining saddles are rather irregular in outline. The first lateral lobe is essentially trifid with denticulated arms. The second lateral lobe is divided in like manner, but the three arms of the lobe are longer.

The ornamentation of the species is not sufficiently strong to be compared with that of the species described by Spath (67, p. 245, pl 19, fig. 1) as belonging to the genus *Diaziceras* Spath, but serves to separate it from *Lenticeras baltae* Lisson (34, pp. 14-14d), which is smooth.

Lenticeras lissoni n. sp.

PLATE XLVI, Figures 1, 2

The cast is involute and moderately stout. The greatest thickness, which is near the umbilicus, is about five-sixths of the height of the whorl. The sides are smooth and converge convexly to the sharply fastigate venter.

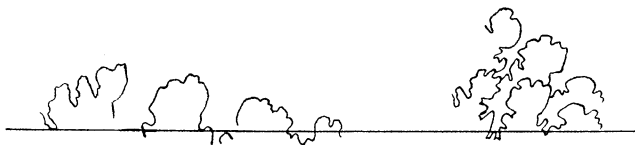


FIGURE 24. Sutures of *Lenticeras lissoni* n. sp. Individual shown in Plate XLVI. Suture to left occurs on weathered portion of specimen; that to right where less weathered. $\times\frac{1}{2}$.

The first lateral saddle is divided into three parts by two deep lobules. The other saddles are rather irregularly indented. The first lateral lobe is essentially trifid, with its arms further divided.

The species is characterized by a whorl intermediate in stoutness between *Lenticeras andii* (Gabb) Gehr. (24, p. 275, pl. 39, fig. 3) (34, pp. 13-13g), which is much inflated, and *Lenticeras baltae* Lisson (34, pp. 14-14d), a moderately compressed form.

FAMILY DESMOCERATIDAE

GENUS DESMOPHYLLITES SPATH, 1929

The genus *Schlüteria* was originally proposed by Grossouvre (26, p. 216) in 1893 for the species from the upper Cretaceous, analogous to *Phylloceras* in form and ornamentation, but in suture more like *Puzosia* and *Pachydiscus*. Grossouvre held that the typical *Phylloceras* is not

represented in beds higher than the Gault. Kossmat (**31**, v. 9, p. 105) (**31**, v. 11, p. 175), in 1895, showed that of the four species assigned by Grossouvre to the new genus *Schlüteria*, three belong to the true *Phylloceras*, and he regarded the fourth, *Schlüteria larteti* (Seunes) as a *Desmoceras* or *Puzosia*. Pervinquière (**47**, pp. 49, 138) in 1907 also discarded the genus *Schlüteria*, but Spath (**68**, p. 129) (**66**, p. 46) (**70**, pt. 1, p. 13) in 1921 revived it with *Schlüteria larteti* (Seunes) as genotype, applying it to the Desmoceratids of the Senonian, "that erroneously, have been included in '*Latidorsella*'."

Later Spath (**73**, p. 270) replaced the name *Schlüteria* by *Desmophyllites*.

Desmophyllites ellsworthi n. sp.

PLATE XLVII, Figures 1, 2 and 3

? *Puzosia gaudama* (Forbes) Kossmat. Brüggén, H., Neues Jahrb., Beilage-Band. 30, 1910, p. 719.

? *Desmoceras* (*Puzosia*) sp. Lüthy, J., Abhandl. Schweiz. Paläont. Ges., v. 43, 1918, p. 50.

This species is represented in the material in hand by a single quarter-whorl fragment.

The greatest thickness, which is somewhat less than two-thirds of the whorl, height, is about half-way between the umbilical shoulder and the venter. The umbilical wall is steep. The venter is well rounded and there is no demarcation between it and the sides. No part of the shell is preserved and the cast is quite smooth except for one constriction which extends radially from the umbilicus to the ventral region, where it bends slightly forward.

The suture is greatly incised. The first lateral lobe extends much farther backward than the ventral lobe and the second lateral lobe. It is trifold in its general outline but each arm is divided several times. The second lateral lobe is bifid. The three visible auxiliary lobes tend to assume a "hanging" attitude.

The suture, as stated by Brüggén and Lüthy in describing their material, agrees closely with that of *Puzosia gaudama* (Forbes) Kossmat (**31**, v. 9, p. 115, pl. 16, figs. 2, 3; pl. 17, fig. 3) (**47**, p. 161, pl. 6, figs. 33, 34), although not in "the smallest details," as claimed by Brüggén. The writer prefers to use different specific names for ammonites collected from such widely separated regions.

PART IV

CRUSTACEA

by

MARY J. RATHBUN

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PART IV

PHYLLUM ARTHROPODA

CLASS CRUSTACEA

SECTION ANOMURA

GENUS CALLIANASSA LEACH

Callianassa peruviana n. sp.

Upwards of 50 specimens of this shrimp-like Decapod were taken from the late lower Cretaceous (Albian) at Pongo do Manseriche, Department of Loreto (Mesozoic locality 11340). All the specimens appear thin and fragile and are of small size, one of the largest measuring (carapace and abdomen) about 35 mm. in length.

The shape of the carapace cannot be made out. In the abdomen segments 2 to 6 are of subequal length, the fourth a little shorter than the others; their epimeral lobes are transversely arcuate (pl. XLVIII, fig. 2; pl. XLIX, fig. 1; pl. L, figs. 2 and 8). The first segment is shown in pl. L, fig. 2. The terminal segment or telson is longer than the preceding segment and as long as the inner of the uropods (pl. XLIX, fig. 2) and has a high median ridge; the proximal half is somewhat roughened. Uropods subequal, broad oval or subrotund, reaching very little beyond the telson.

Chelipeds of first pair very unequal, the minor one less than half as wide as the major (pl. XLVIII, fig. 1; pl. XLIX, fig. 3; pl. L, fig. 7). Outer surface of major merus (pl. L, fig. 1) less than twice as long as high, upper portion very thick and semicylindrical, lower portion a thin lamina, from which proceeds on the proximal half a strong, outstanding, slightly curved spine. Outer surface of carpus and manus very convex from top to bottom. Carpus as broad as long, lower edge thin and margined. Manus two-thirds as broad as long, suboblong, narrowing more or less toward the distal end, upper and lower margins very slightly arched. The squarer palms belong probably to the male (pl. XLIX, fig. 1; pl. L, figs. 2, 3 and 4), and the more tapering ones to the female (pl. XLVIII, fig. 1; pl. XLIX, figs. 3 and 4; pl. L, figs. 1, 5, 6 and 7). Lower margin of propodus including finger armed with short, spaced spinules pointing distad and more distant on finger than on palm (pl. L, fig. 5); these may repre-

sent projecting sockets for hairs. Outer surface of palm rough with elongate pustules transversely placed and disappearing on the lower portion (pl. XLIX, figs. 1 and 3; pl. L, figs. 1 and 4-7). Fingers meeting at base and equally wide and long (pl. XLIX, figs. 3 and 4; pl. L, figs. 1 and 5), their outer margins curving toward each other. Prehensile edges fitting together when closed, margin of propodal finger thickened (pl. XLIX, fig. 4; pl. L, fig. 6), a large triangular tooth at middle; prehensile edge of dactylus entire, slightly sinuous, some submarginal punctae (pl. XLIX, fig. 4).

In the minor cheliped of the first pair, the carpus is one and a half times longer than wide, the palm is about one and a half times longer than wide (pl. XLVIII, fig. 1; pl. XLIX, fig. 3), sides straight and almost parallel; both articles are very convex outside from top to bottom. Propodal finger shorter than palm, inclined strongly downward and tapering to a sharp point (pl. XLVIII, fig. 1; pl. L, fig. 7). Dactylus considerably longer than immovable finger, widest in its proximal half.

Callianassa infracretacea de Tribolet (81a, p. 352, pl. 12, fig. 2) from the lower Neocomian of Switzerland has a similar major palm with subparallel sides but the immovable finger is at base only one-third as wide as the distal end of the palm.

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DESCRIPTION OF PLATES

PLATE I

Holcotypus planatus Römer var. *numismalis* Gabb.

Figs. 1, 2, 3. Aboral, left ambital, and oral views respectively. Collection 317. x1

Ennalaster peruanus Gabb.

Figs. 4, 5, 6. Aboral, left ambital, and oral views respectively. Collection 317. x1

Hemiaster fourneli var. *obliquus* Brüggen.

Figs. 7, 8, 9. Aboral, right ambital, and oral views respectively. Collections 44, 50, 51, and 307. Figured specimen from No. 307. x1

Nucula turgida n. sp.

Figs. 10, 11. Holotype. Right lateral and umbonal views respectively. Collection 317. x1

Nucula pongensis n. sp.

Figs. 12, 13. Holotype. Left lateral and umbonal view respectively. Collection 6. x1

Cucullaea andersoni n. sp.

Figs. 14, 15. Holotype. Left valve. Exterior and interior views respectively. Collection 35. x1

PLATE II

Botriopygus compressus Gabb.

Figs. 1, 2, 3. Aboral, right ambital and oral views respectively. Collection 317. x1

Ennalaster roschemi n. sp.

Figs. 4, 5, 6. Holotype. Aboral, left ambital, and oral views respectively. Collection 317. x1

Cucullaea reesideana n. sp.

Figs. 7, 8, 9. Cotypes. Hinge of right valve, umbonal view, and exterior of right valve respectively. Collection 38. x1

PLATE III

Pholadomya quinuana Neumann.

Figs. 1, 2. Umbonal view, and exterior of left valve respectively. Collection 46. Found also in collection 50. x1

Cucullaea gabrielis Leymerie. (?)

Figs. 3, 4. External view of right valve and umbonal view of same specimen respectively. Collection 317. x1

PLATE IV

Exogyra n. sp. aff. *E. africana* Coquand.

Figs. 1, 2. Holotype, left valve. Exterior view and umbonal view respectively. Collection 6. x1

Inoceramus sp.

Fig. 3. View of fragment. Collection 307. x1

Pinna decussata Goldfuss ?

Fig. 4. View of left valve. Collection 307. x1

Arca knechteli n. sp.

Figs. 5, 6. Holotype. View of right side and umbonal view respectively. Collection 6. x1

Exogyra flabellata Goldfuss ?

Fig. 7. Exterior of left valve. Collection 310. x1

Inoceramus concentricus Parkinson.

Figs. 8, 9. Posterior view and exterior view of left valve respectively. x1

Arca megumbona n. sp.

Figs. 10, 11. Holotype. Left valve. Internal view and external view respectively. Collection 6. x1

PLATE V

Ostrea nicaisi H. Coquand.

Fig. 1. Lateral view of same specimen figured on plate VI, figs. 1, 2. Collections 46 and 307; figured specimen from collection 307. x1

Turritella - roscheni n. sp.

Fig. 2. Cotypes. Collection 134. x1

PLATE VI

Ostrea nicaisi H. Coquand.

Figs. 1, 2. Same specimen as plate V, fig. 1. Free or convex valve and attached or concave valve respectively. Collection 307. x1

PLATE VII

Plicatula singewaldi n. sp.

Fig. 1. Holotype. Exterior view of right valve. Collection 6. x1

Pecten (Neithea) morrissi (Pictet and Renevier).

Figs. 2, 3. Anterior view of right valve and exterior of right valve respectively. Collection 317. x1

Trigonia subcrenulata d'Orbigny.

Fig. 4. Exterior of left valve. Collection 317. x1

Plicatulopecten bohni Neumann.

Figs. 5, 6. Two views of specimens from collection 50. It occurs also in collections 44, 46, and 51. x1

Pecten raimondi Gabb.

Fig. 7. Exterior view of a fragment of a valve. Collection 6. x1

Trigonia hondaana Lea.

Fig. 8. Exterior of fragmentary left valve. Collection 117. x1

Trigonia mathewsi n. sp.

Figs. 9, 10. Umbonal view of cotype and exterior view of left valve of another cotype respectively. Collection 205. x1

PLATE VIII

Lima silinensis n. sp.

Fig. 1. Holotype. Left valve. Collection 317. x1

Pholadomya sp.

Figs. 2, 3. Posterior end of right valve, and posterior view of same specimen respectively. Collection 34. x1

Modiola pongana n. sp.

Figs. 4, 5. Cotypes. Umbonal view of one specimen and right valve of another specimen respectively. Collection 317. x1

Pholadomya silinensis n. sp.

Figs. 6, 7. Holotype. Umbonal view and left valve respectively. Collection 317. x1

Pholadomya pongensis n. sp.

Figs. 8, 9. Holotype. Exterior of right valve and umbonal view respectively. Collection 6. x1

Anatina silinensis n. sp.

Figs. 10, 11. Holotype. Umbonal view and view of left valve respectively. x1

Plicatulopecten ferryi (Coquand) var. *concentricus* Brüggen.

Fig. 12. Exterior of a valve from collection 307. x1

Liopistha sp. aff. *L. (Psilomya) gigantea* Sowerby.

Fig. 13. Exterior of cast of a left valve. Collection 6. Also found in collection 348. x1

PLATE IX

Protocardia n. sp. aff. *P. hillana* (Sowerby).

Figs. 1, 2, 3. Cotypes. Posterior view of an internal cast, left lateral view and view of a compressed left valve respectively. Collection 6. x1

Turritella sp. indet.

Fig. 4. Collection 50. The genus also occurs in collections 46 and 51. x1

Fusinus ? sp. indet.

Fig. 5. Collection 36. x1

Lima ellsworthi n. sp.

Fig. 6. Holotype. Exterior of left valve. Collection 46. x1

PLATE X

Roudairia intermedia Brüggen.

Figs. 1, 2, 3, 4. View of left valve, view of right valve of another specimen, anterior view of specimen shown in fig. 2, and umbonal view of same specimen respectively. Collection 42. x1

Anisocardia ? sp.

Figs. 5, 6. View of right side of cast, and view of posterior end of cast respectively. Collection 327. x1

Cardium centralis n. sp.

Fig. 7. Holotype. Cast of right valve. Collection 51. Found also in collection 307. x1

Epitonium pongensis n. sp.

Fig. 8. Holotype. Collection 6. x1

Natica sp. indet.

Fig. 9. Collection 316. x1

Natica cf. *N. larteti* Landerer.

Figs. 10, 11. Apex and side view, respectively. x1

Cardium watsoni n. sp.

Fig. 12. Holotype. Right valve. Collection 30. x1

Paphia peruana n. sp.

Figs. 13, 14. Holotype. Umbonal view and view of left valve respectively. Collection 6. x1

Protocardia meridionalis n. sp.

Figs. 15, 16, 17. Cotypes. Umbonal view, view of left valve, and view of right valve of a larger individual respectively. Collection 6. x1

PLATE XI

Protocardia berrii n. sp.

Figs. 1, 2. Holotype. Left valve and view of posterior end of shell respectively. Collection 316. x1

Volutilithes ? sp. indet.

Figs. 3, 4. Part of the spire, and outlines of part of the body whorl, respectively. x1

PLATE XII

Natica lesseli Brüggén.

Figs. 1, 2. Side view, and apical view respectively. Collection 307. x1

PLATE XIII

Perisphinctes cf. *contiguus* (Catullo) Zittel.

Figs. 1, 2, 3. Front, side and back views, respectively; internal cast, fragment. Collection 320. x1

Perisphinctes aff. *densistriatus* Steuer.

Figs. 4, 5, 6. Back, side and front views, respectively; internal cast. Collection 320. x1

PLATE XIV

Perisphinctes cf. *pouzinensis* Toucas.

Figs. 1, 2, 3. Front, side, and back views, respectively; internal cast. Collection 320. $\times 1$

Perisphinctes sp.

Figs. 4, 5, 7. Back, side, and front views, respectively; fragment of internal cast. Collection 163. $\times 1$

Perisphinctes cf. *gevreyi* Toucas.

Figs. 6, 8, 9. Front, back, and side views, respectively; fragment of internal cast. Collection 163. $\times 1$

PLATE XV

Knemiceras semicostatum Sommermeier.

Figs. 1, 2. Side and front views, respectively; internal cast retaining pieces of shell. U. S. National Museum Collection 11340. $\times 1$

Fig. 3. Back view of fragment showing ventral lobe of suture. U. S. National Museum Collection 11340. $\times 1$

Perisphinctes aff. *tiziani* Oppel.

Figs. 4, 5, 6. Front, back, and side views, respectively; fragment of internal cast. Collection 163. $\times 1$

PLATE XVI

Knemiceras attenuatum (Hyatt) Krause.

Fig. 1. Front view of internal cast. Collection 6. $\times 1$

Knemiceras crassinodosum Sommermeier.

Fig. 2. Side view; fragment of internal cast of large individual. U. S. National Museum Collection 11340. $\times 1$

Knemiceras attenuatum (Hyatt) Krause var. *spinosa* Sommermeier.

Figs. 3, 4. Side and back views, respectively; internal cast. Collection 6. $\times 1$

PLATE XVII

Knemiceras bassleri n. sp.

Figs. 1, 2. Back and side views; internal cast. Collection 317. $\times 1$

PLATE XVIII

Knemiceras crassicosatum Sommermeier.

Figs. 1, 2. Side and front views, respectively; internal cast. Collection 6. $\times 1$

Tissotia waltheri n. sp.

Figs. 3, 4. Side and front views, respectively; fragment of internal cast. Collection 33. Slightly reduced.

Knemiceras sommermeieri n. sp.

Figs. 5, 6. Side and back views, respectively; internal cast. U. S. National Museum Collection 11340. $\times \frac{2}{3}$

PLATE XIX

Knemiceras crassicostatum Sommermeier.

Figs. 1, 2. Side and front views, respectively; fragment of internal cast. U. S. National Museum Collection 11340. x1

Knemiceras raimondi Lisson.

Figs. 3, 4. Side and back views, respectively; fragment of internal cast. Collection 317. x1

PLATE XX

Knemiceras crassinodosum Sommermeier.

Figs. 1, 2. Front and side views, respectively; internal cast. Collection 133. x1

Knemiceras raimondi Lisson.

Fig. 3. Side view; 2 fragments of internal cast. Collection 317. x1

PLATE XXI

Knemiceras moorei n. sp.

Figs. 1, 2. Back and side views; internal cast. U. S. National Museum Collection 11340. x1

Lyelliceras mathewsi n. sp.

Figs. 3a. Side view; internal cast. Collection 6. x1

Figs. 3b, 3c. Same specimen; back and side views, respectively, of inner whorl. x6

Brancoceras aegoceratoides Steinmann.

Figs. 4a, 4b, 4c. Back, side and front views; internal cast, fragment. Collection 318. x1

Brancoceras quenstedti n. sp.

Figs. 5a, 5b. Side and back views, respectively; internal cast. U. S. National Museum Collection 11340. x1

PLATE XXII

Knemiceras sp.

Figs. 1a, 1b. Front and side views, respectively; fragment of internal cast. U. S. National Museum Collection 11340. x1

PLATE XXIII

Lyelliceras ulrichi n. sp.

Figs. 1a, 1b. Side and back views, respectively; internal cast. U. S. National Museum Coll. 11340. x1

Mojsisovicsia gabbi n. sp.

Figs. 2a, 2b. Back and side views, respectively; fragment of internal cast. U. S. National Museum Collection 11340. x1

PLATE XXIV

Oxytropidoceras douglasi n. sp.

Figs. 1, 2. Sectional and side views, respectively; fragment of internal cast. Collection 6. x1

Figs. 3, 4. Front and side views, respectively; fragment of internal cast. U. S. National Museum Collection 11340. x1

PLATE XXV

Oxytropidoceras douglasi, n. sp.

Fig. 1. Side view; fragment of internal cast. Collection 6. x1

Fig. 2. Side view; fragment of internal cast. U. S. National Museum Collection 11340. x1

PLATE XXVI

Oxytropidoceras douglasi n. sp.

Side view; internal cast. Collection 6. x2

PLATE XXVII

Oxytropidoceras (Manuaniceras) bösei n. sp.

Fig. 1. Side view; fragment of internal cast. Collection 6. x1

Oxytropidoceras douglasi n. sp.

Figs. 2, 3. Side and front views, respectively; internal cast fragment. U. S. National Museum Collection 11340. x1

Oxytropidoceras (Manuaniceras) carbonarium (Gabb).

Fig. 4. Side view; fragment on which shell is preserved except in a small area near the venter. Collection 165. x1

PLATE XXVIII

Oxytropidoceras douglasi n. sp.

Fig. 1. Side view; internal cast. Collection 6. x1

Oxytropidoceras (Manuaniceras) carbonarium (Gabb).

Fig. 2. Front view of specimen shown in Plate XXIX. x1

Oxytropidoceras (Manuaniceras) hubbardi n. sp.

Fig. 3. Side view; internal cast. Collection 6. x1

PLATE XXIX

Oxytropidoceras (Manuaniceras) carbonarium (Gabb).

Side view; specimen retaining most of shell. U. S. National Museum Collection 11340. x1

PLATE XXX

Dowwillericeras sp.

Fig. 1. Back of fragment. x1

Fig. 2. Sectional view of same fragment. Collection 316. Greatly reduced.

PLATE XXXI

Tissotia reesideana n. sp.

Side view; internal cast. Collection 27. x5/6

PLATE XXXII

Tissotia reesideana, n. sp.

Fig. 1. Front view of specimen shown in Plate XXXI. x5/6

Tissotia steinmanni Lisson.

Fig. 2. Front view of specimen shown in Plate XXXIII. x5/6

PLATE XXXIII

Tissotia steinmanni Lisson.

Side view, internal cast. Collection 27. x5/6

PLATE XXXIV

Barroisiceras grossouvrei n. sp.

Figs. 1a, 1b. Side and back views, respectively; fragment of internal cast.
Collection 26. x1

Heterotissotia lissoni, n. sp.

Fig. 2a, 2b. Side and back views, respectively; individual with parts of shell preserved. Collection 38. x1

Tissotia singewaldi n. sp.

Figs. 3a, 3b. Front and side views, respectively; internal cast. Collection 37. x1

PLATE XXXV

Tissotia andii n. sp.

Side view; specimen retaining most of the shell. Collection 31. x1

PLATE XXXVI

Tissotia andii n. sp.

Front view of specimen shown in Plate XXXV. x1

PLATE XXXVII

Lenticeras baltae Lisson.

Fig. 1. Cross section of living chamber of specimen shown in Plate XLIV. x1

Tissotia compressa n. sp. var. *levis* n. var.

Fig. 2. Side view; internal cast. Collection 33. x1

Tissotia stephensoni n. sp.

Figs. 3, 4, 5. Side, front and side views, respectively; internal cast. Collection 36. x1

Tissotia compressa n. sp.

Figs. 6, 7. Front and side views; internal cast retaining part of living chamber. Collection 34. x1

PLATE XXXVIII

Tissotia roscheni n. sp.

Figs. 1, 2. Side and front views; internal cast. Collection 42. x 5/6

PLATE XXXIX

Tissotia obesa n. sp.

Side view; internal cast. Collection 42. x1

PLATE XL

Tissotia obesa, n. sp.

Front view of specimen shown in Plate XXXIX. x1

PLATE XLI

Barroisiceras brüggeni n. sp.

Figs. 2, 3, 4. Front, side and back views; internal cast. Collection 50. x1

Tissotia halli n. sp.

Figs. 1, 5. Side and front views; internal cast. Collection 49. x1

PLATE XLII

Buchiceras bilobatum Hyatt emend. Brüggen.

Side view; poorly preserved internal cast. Collection 42. x1

PLATE XLIII

Eulophoceras berryi n. sp.

Figs. 1, 2. Side and front views, respectively; internal cast. Collection 37. x1

PLATE XLIV

Lenticeras baltæ Lisson.

Side view; fragment of internal cast; parts of living chamber and of septate portion. Collection 51. x1

PLATE XLV

Lenticeras gerhardtii n. sp.

Figs. 1, 2. Front and side views, respectively; internal cast. Collection 51. x1

PLATE XLVI

Lenticeras lissoni n. sp.

Figs. 1, 2. Side and front views, respectively; internal cast. Collection 35. x5/6

PLATE XLVII

Desmophyllites ellsworthi n. sp.

Figs. 1, 2. Back and side views, respectively; internal cast, fragment. Collection 33. x3

Fig. 3. Section of forward end of figured specimen. x1

PLATE XLVIII

Callianassa peruviana, n. sp.

Fig. 1. First pair of chelipeds of ♀. x8

Fig. 2. Abdomen and chelipeds. x8

PLATE XLIX

Callianassa peruviana, n. sp.

Fig. 1. Major cheliped and abdomen of ♂. x2

Fig. 2. Tail fan and three last segments of abdomen. x8

Fig. 3. First pair of chelipeds of ♀. x2

Fig. 4. Major chela of ♀. x8

PLATE L

Callianassa peruviana, n. sp.

Fig. 1. Counterpart of major cheliped of ♀. x4

Fig. 2. Major cheliped and abdomen of ♂. x2

Fig. 3. Propodus of major chela of ♂. x4

Fig. 4. Major cheliped of ♂. x2

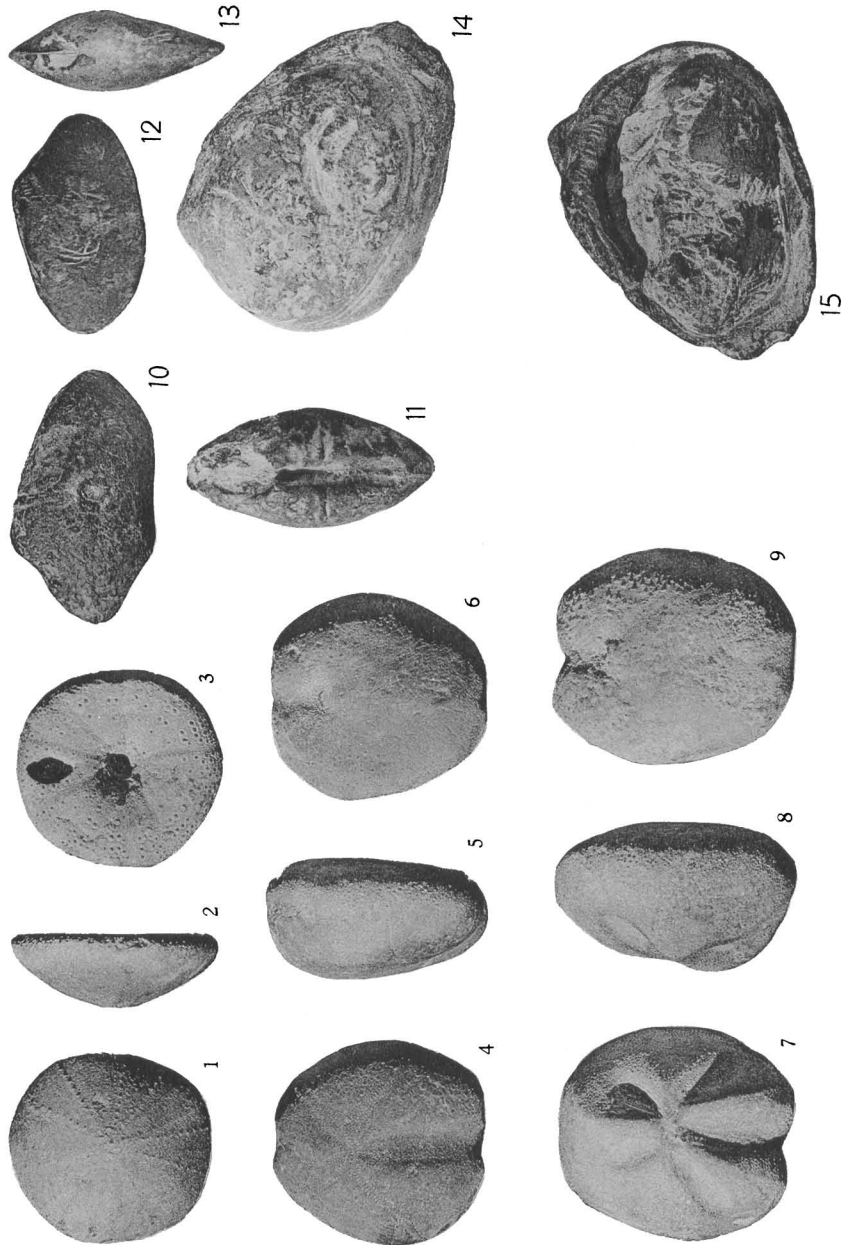
Fig. 5. Major chela of ♀. x4

Fig. 6. Propodus of major chela of ♀. x4

Fig. 7. First pair of chelipeds of ♀. x4

Fig. 8. Abdomen. x4

PLATES





8



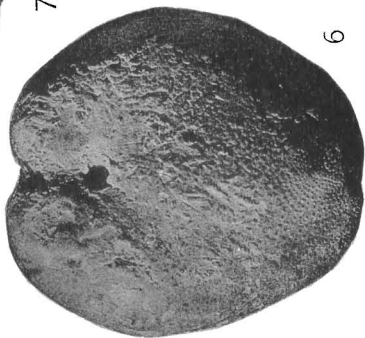
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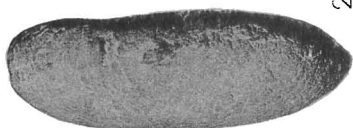
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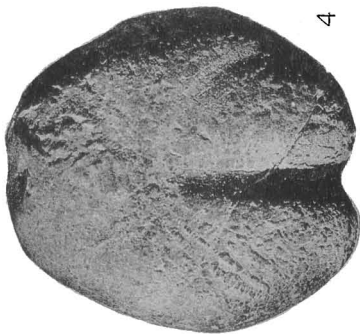
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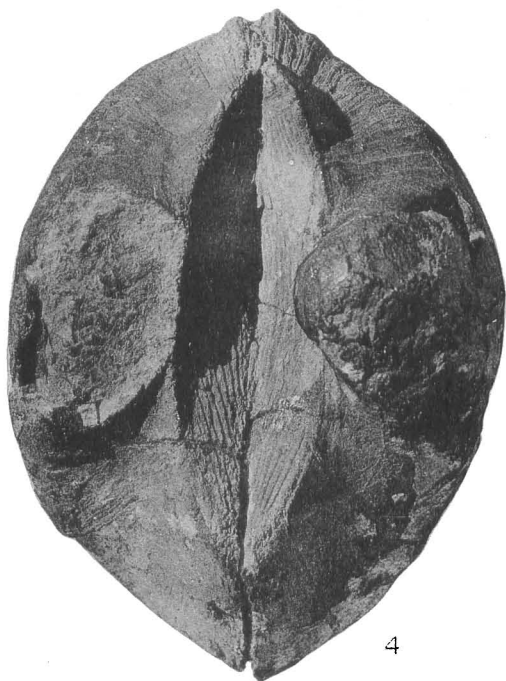
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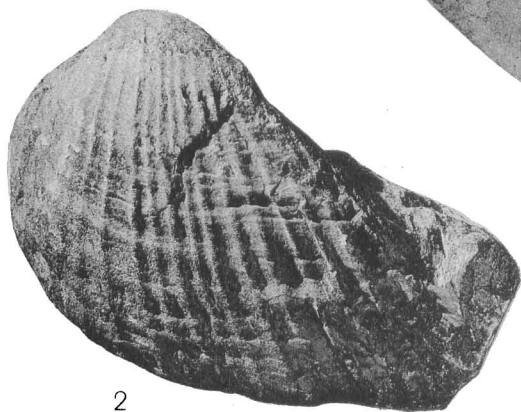
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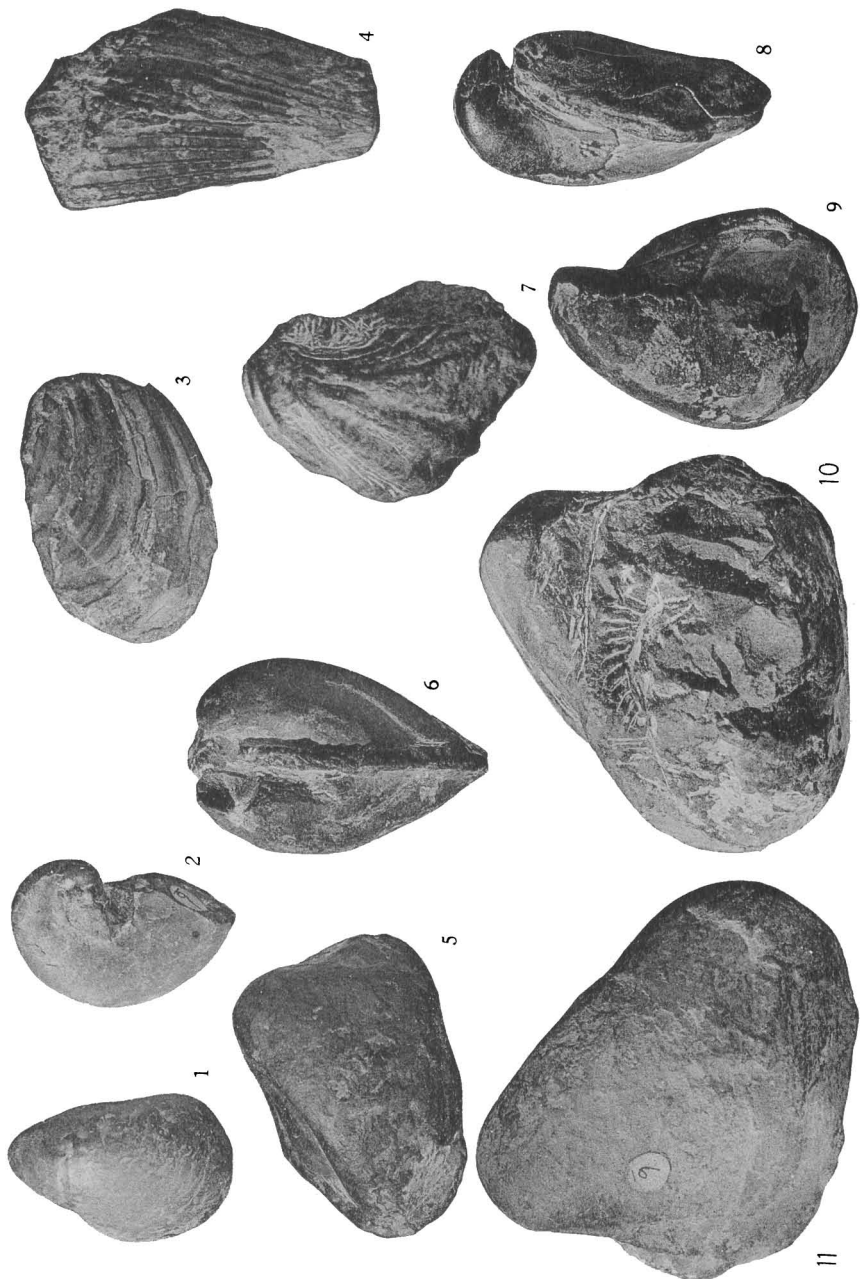
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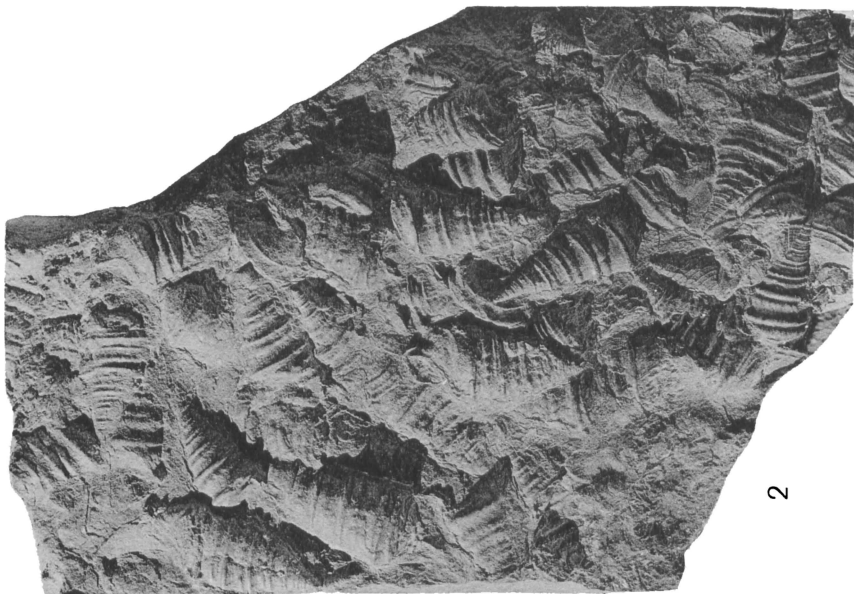


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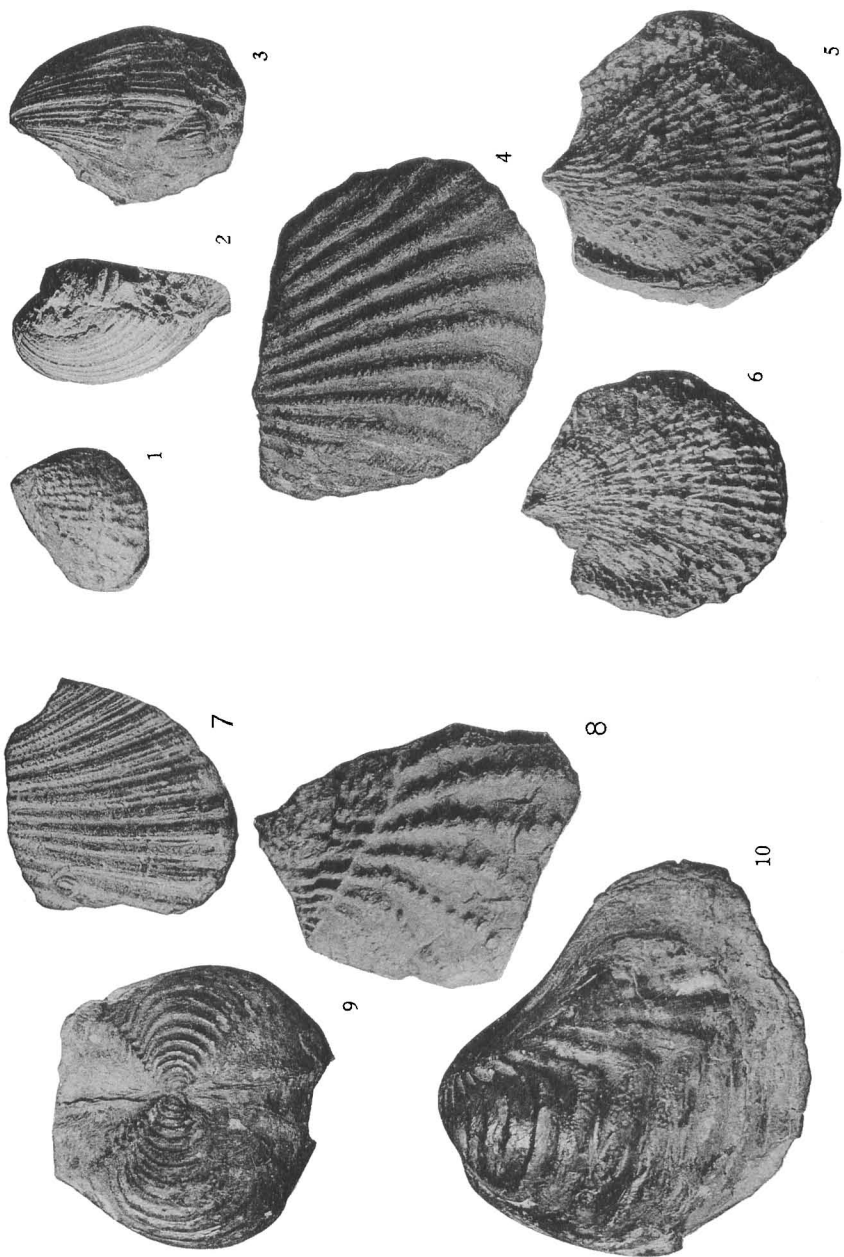


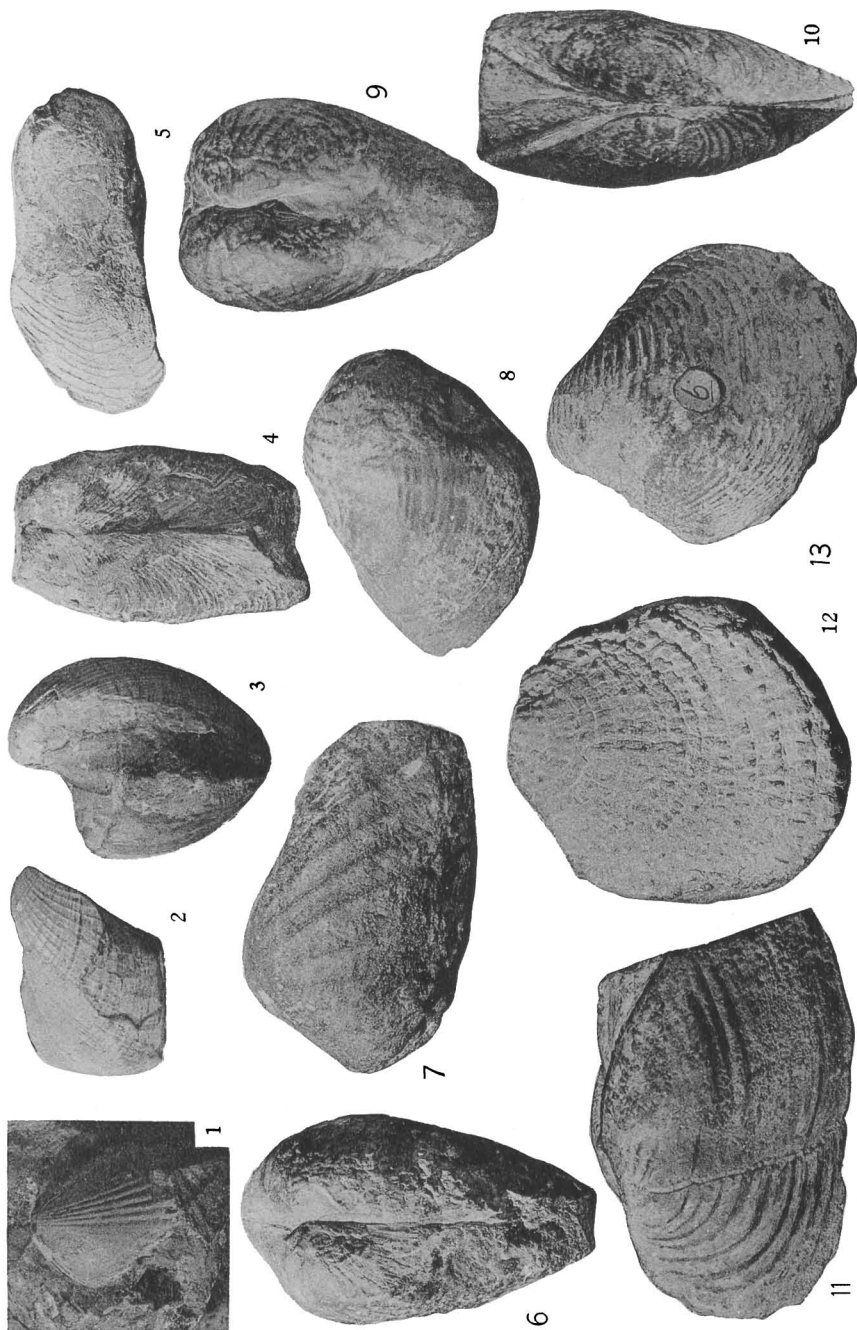
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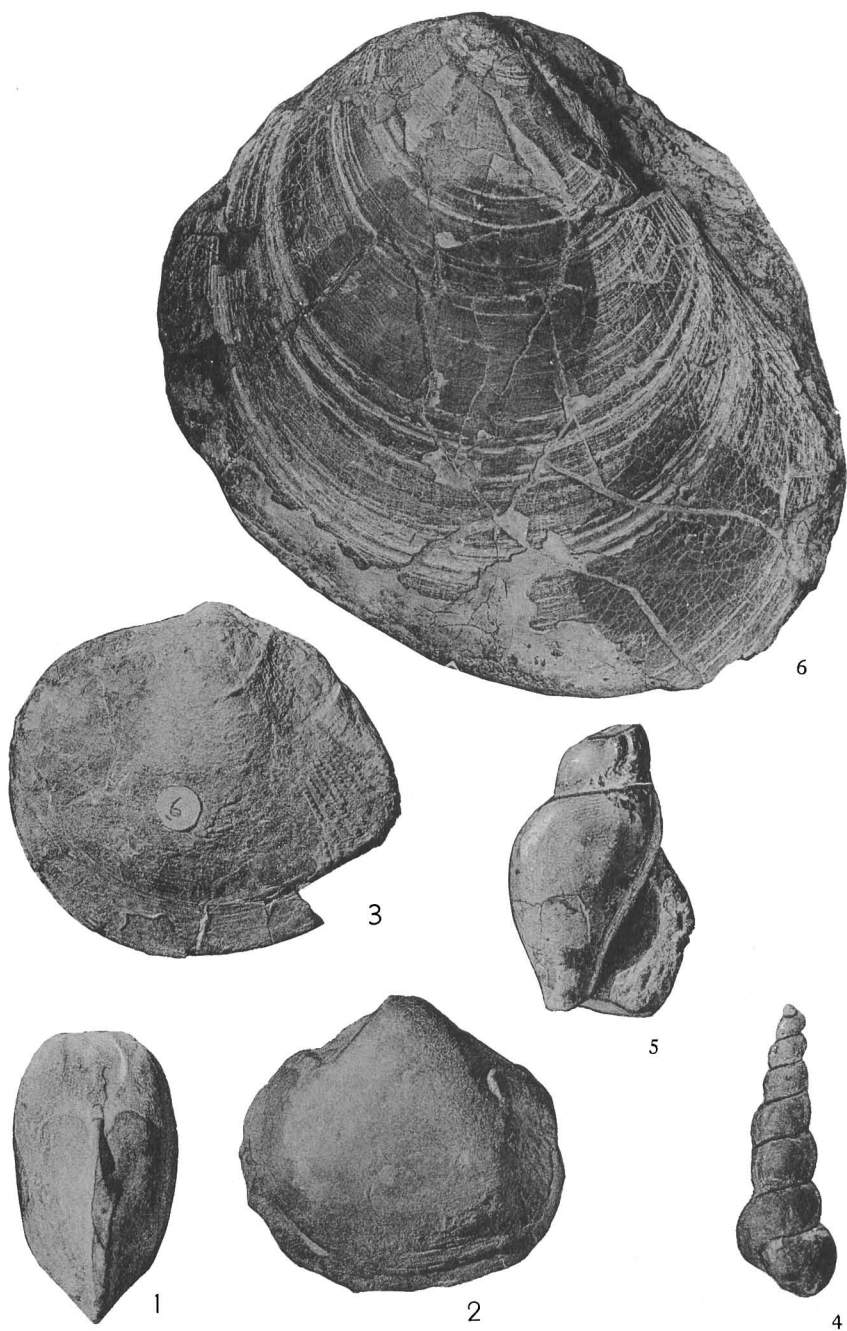


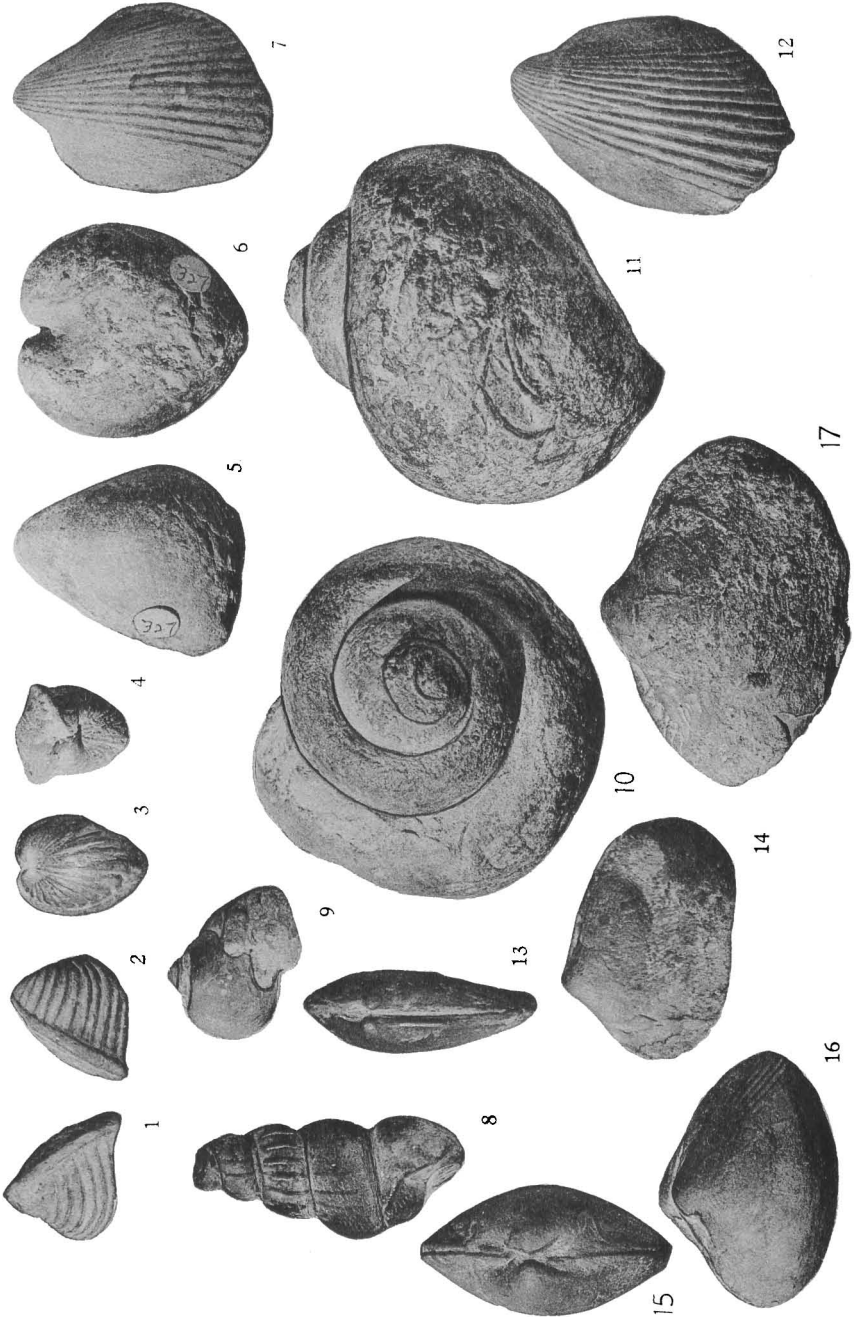


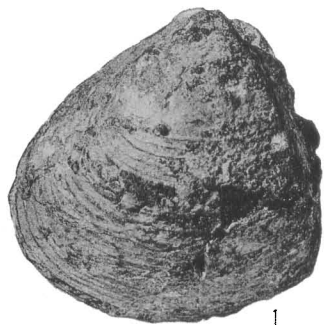












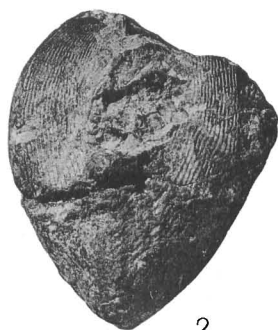
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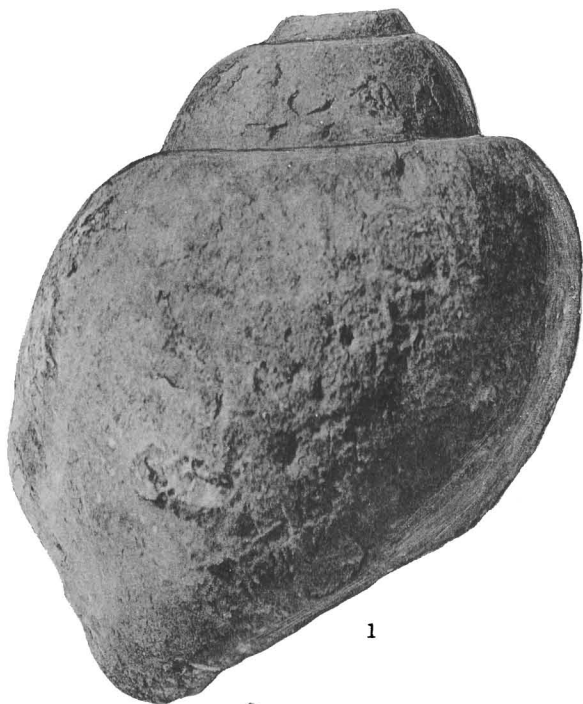
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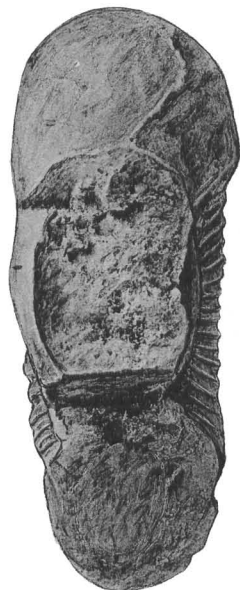
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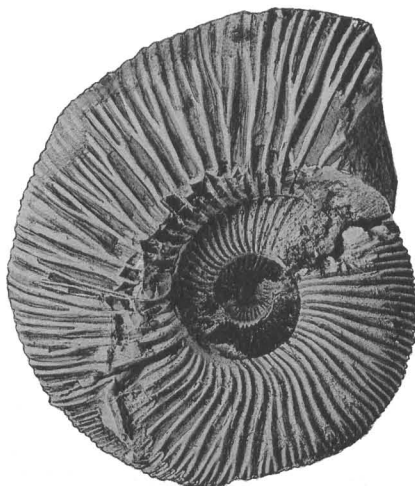
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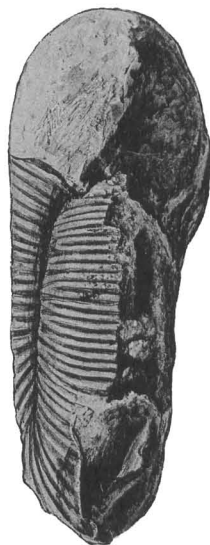
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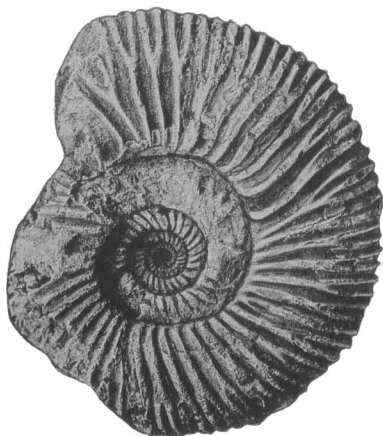
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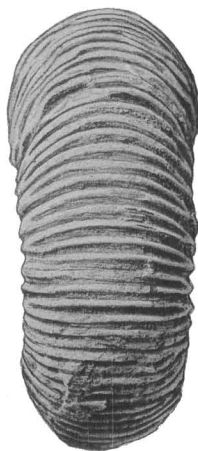
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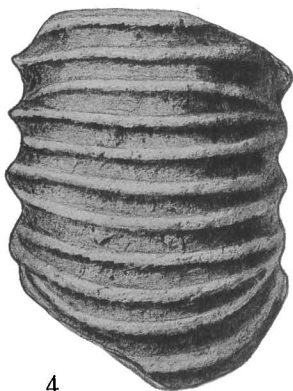
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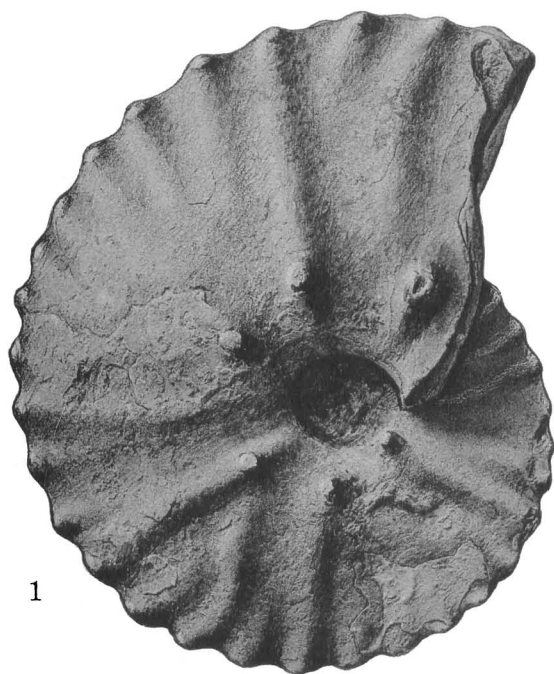
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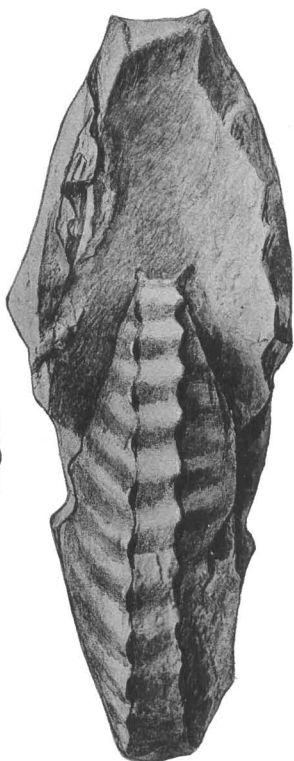
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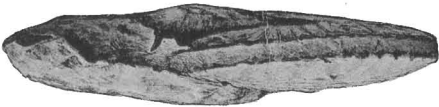
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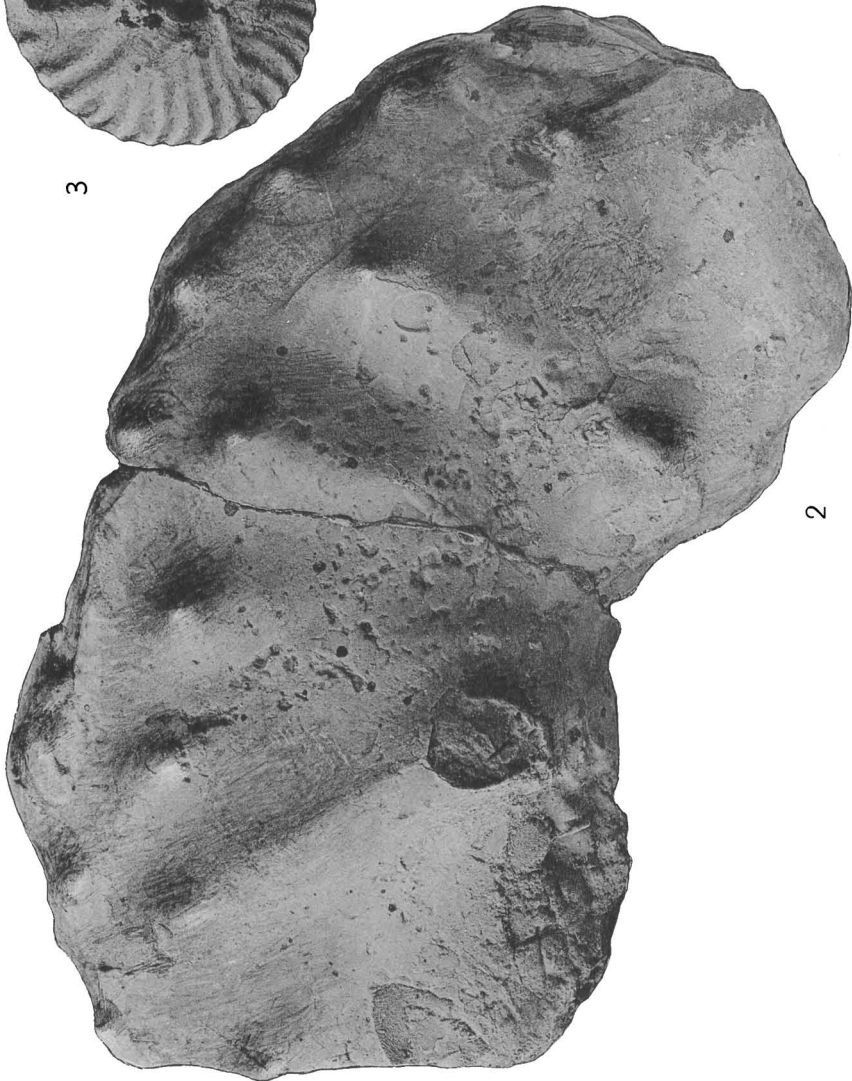
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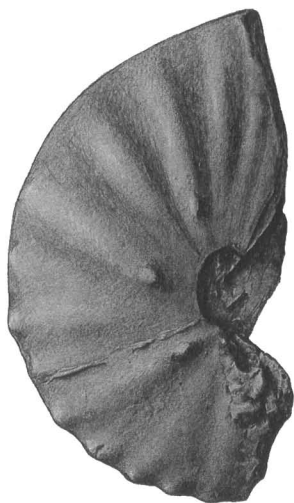
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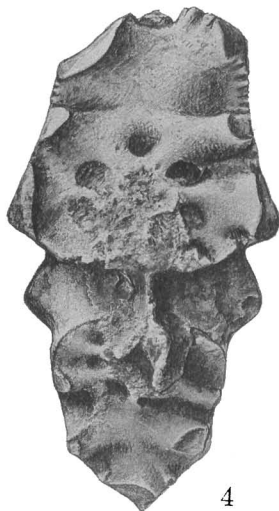
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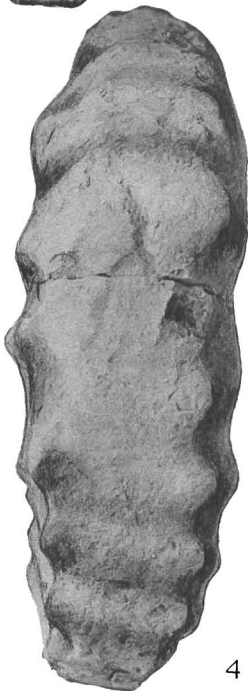
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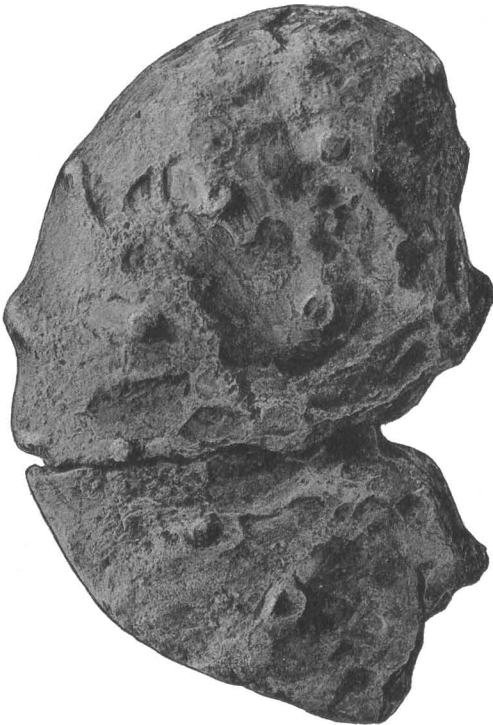




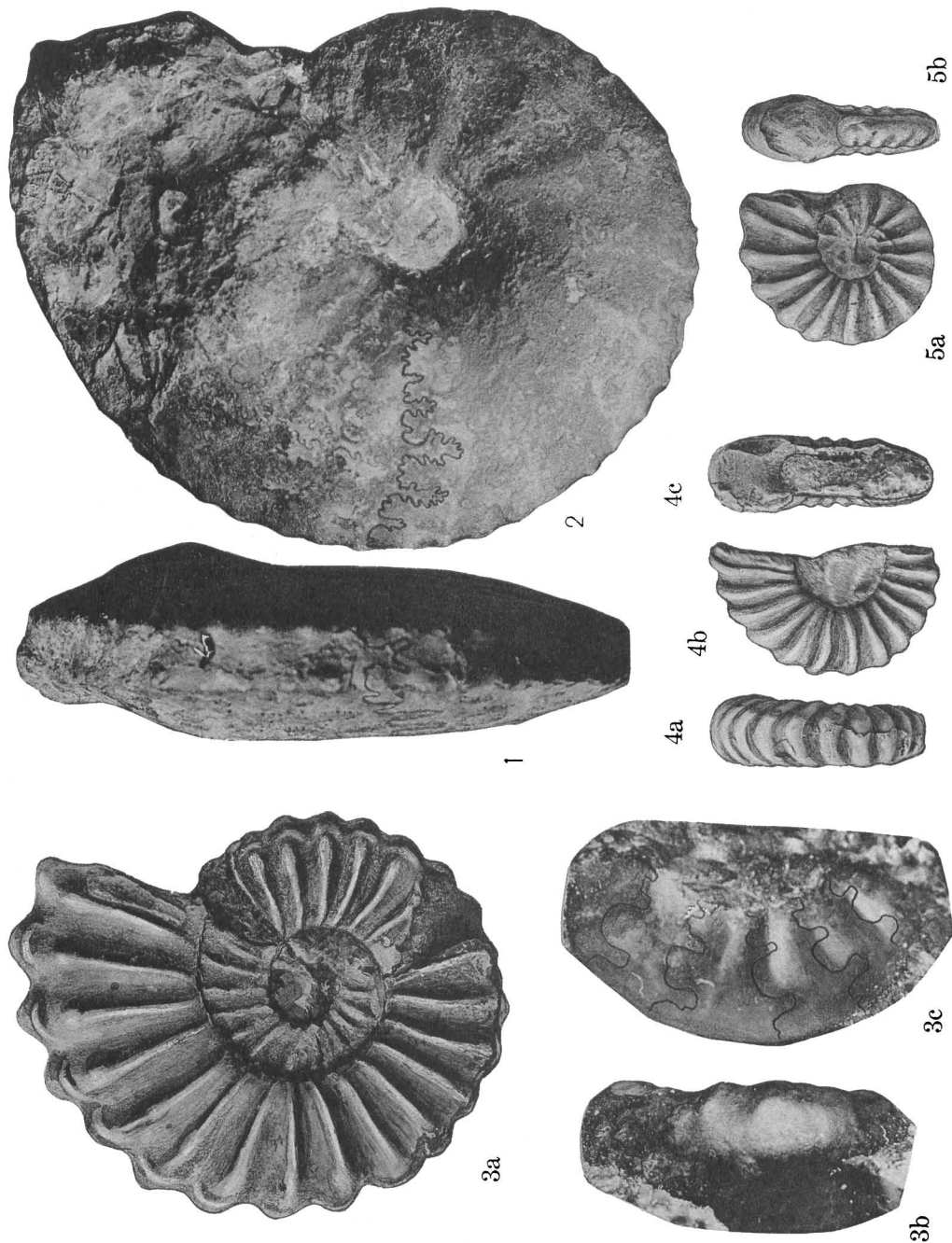
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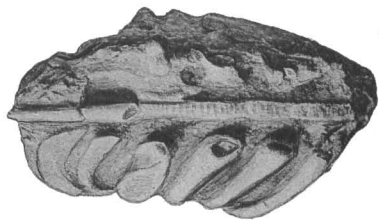




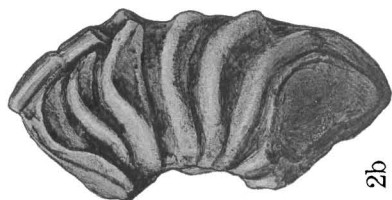
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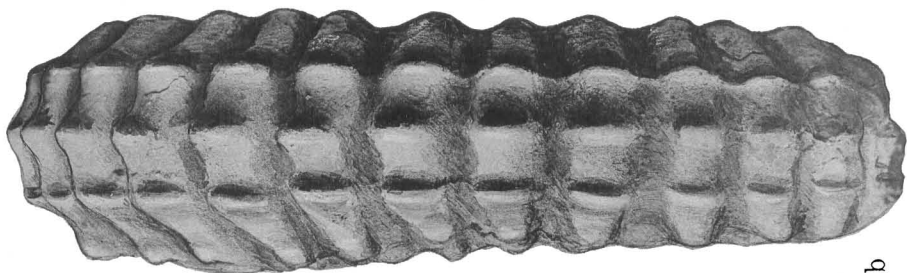
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2a



2b

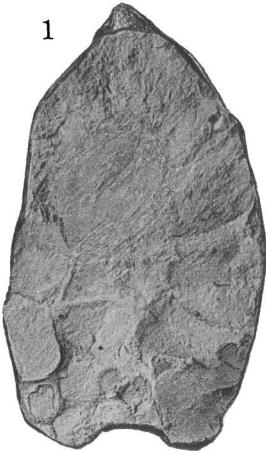


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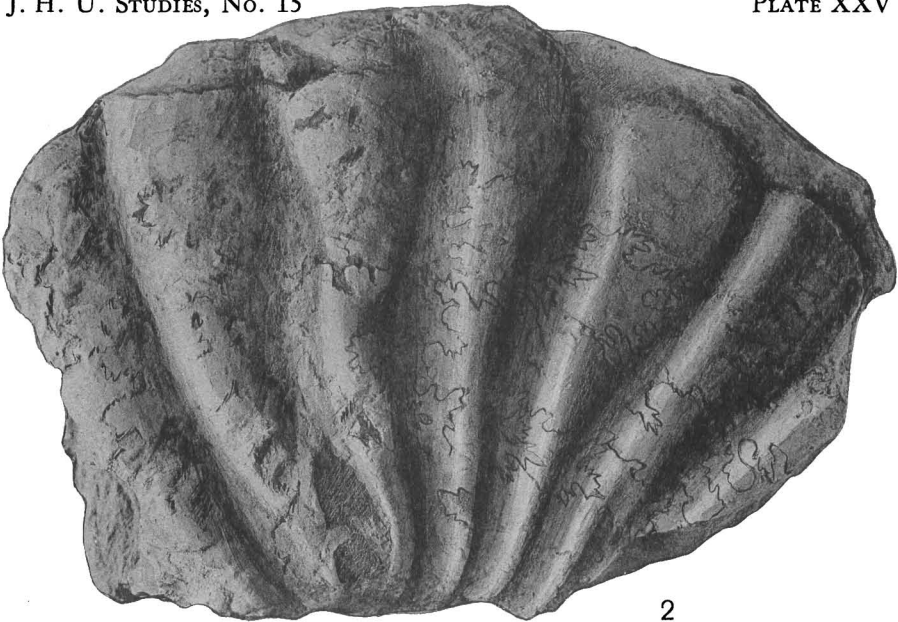


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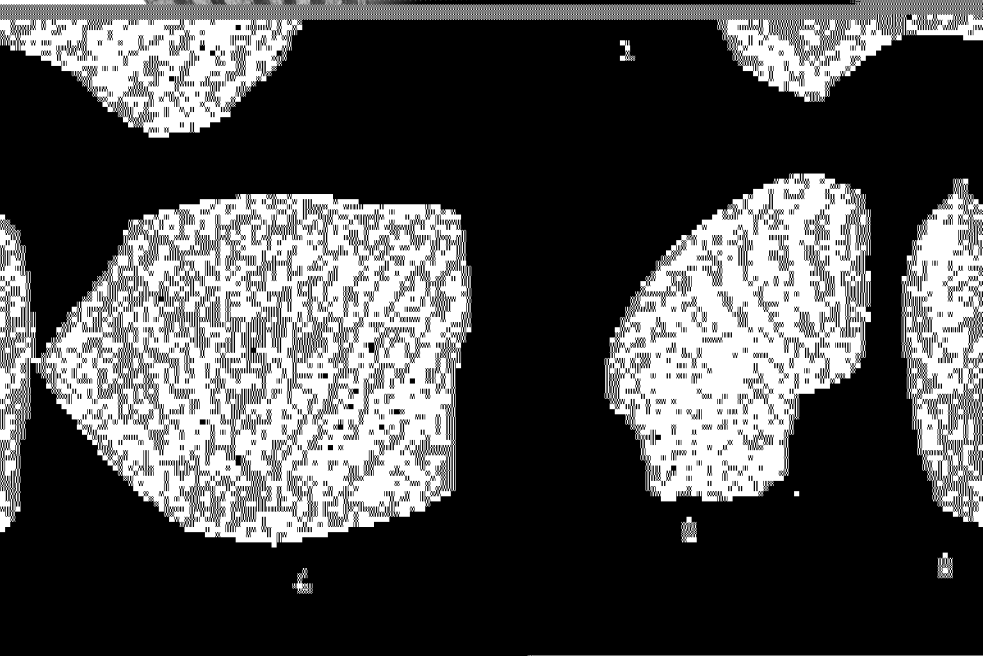


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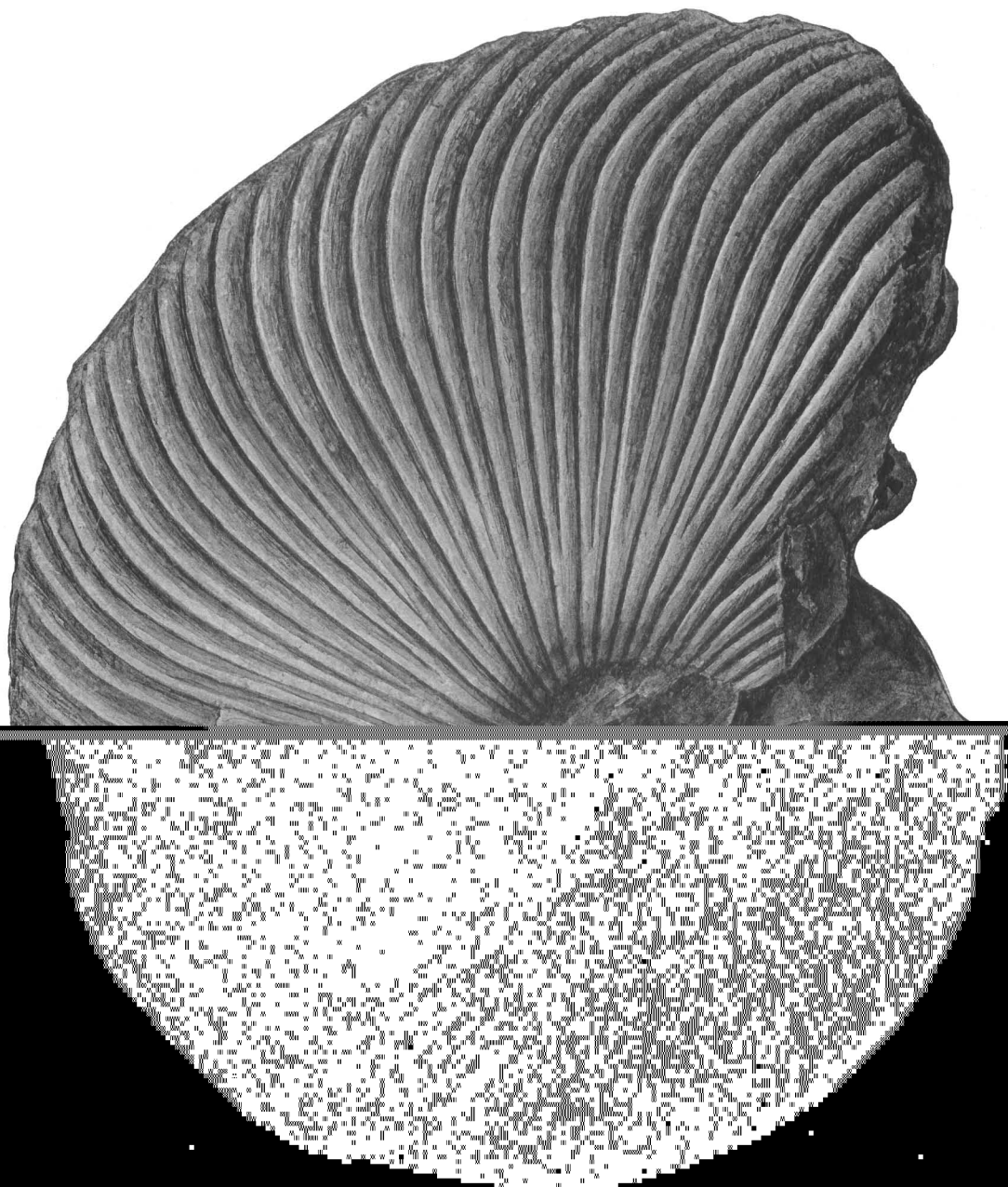














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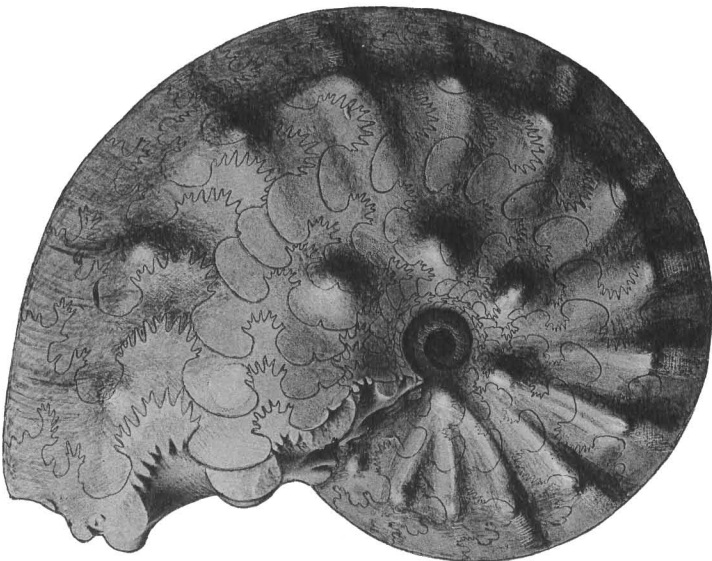


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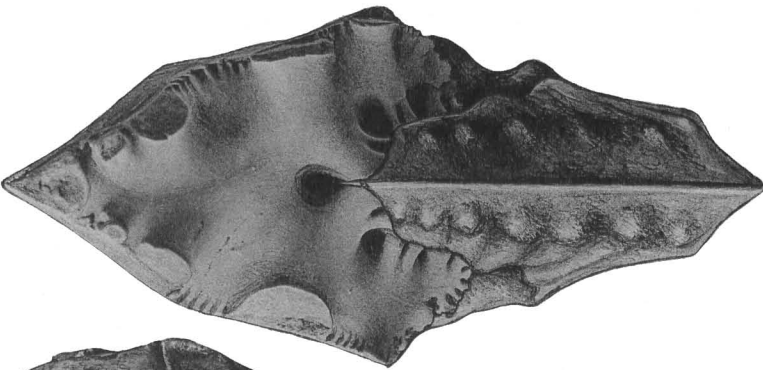


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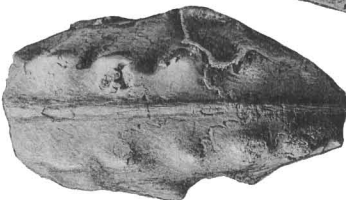




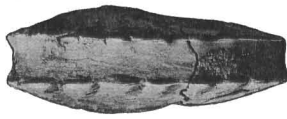
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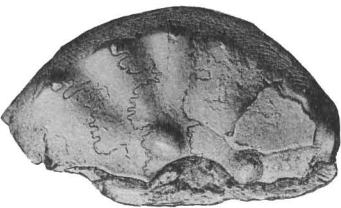
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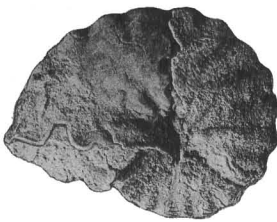
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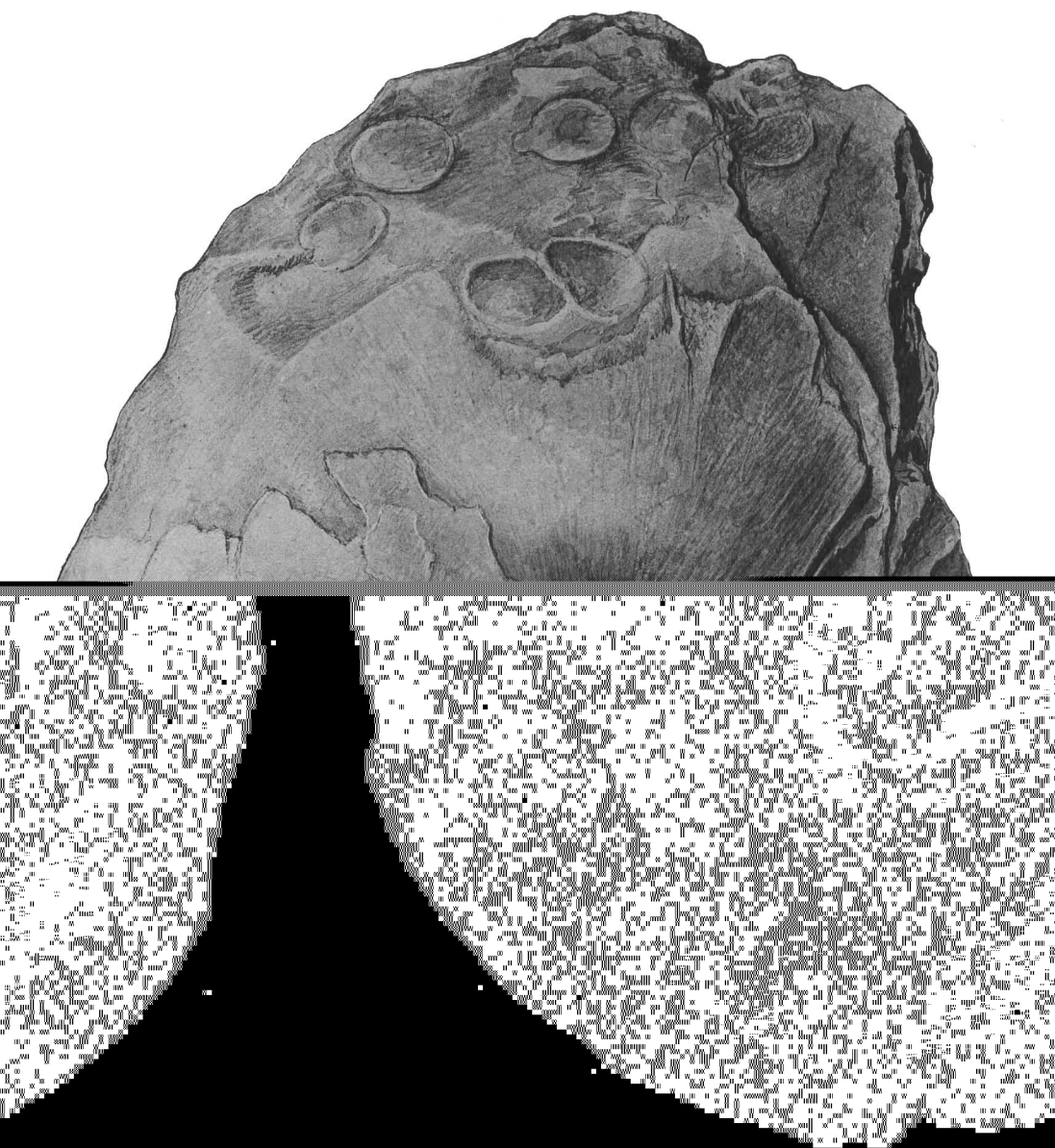
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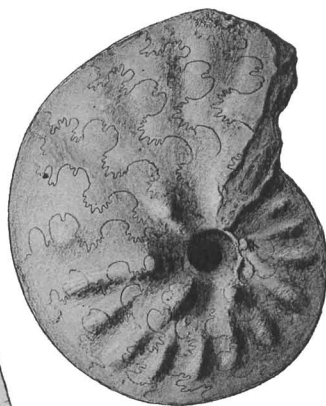
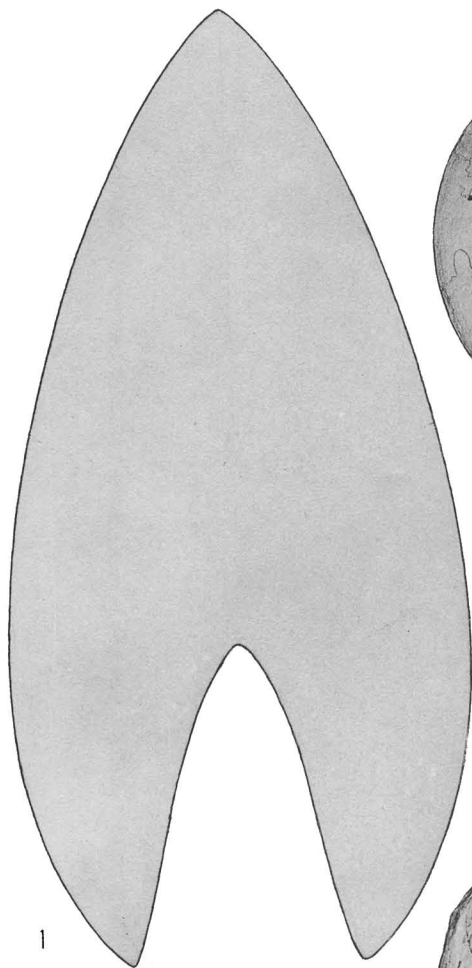
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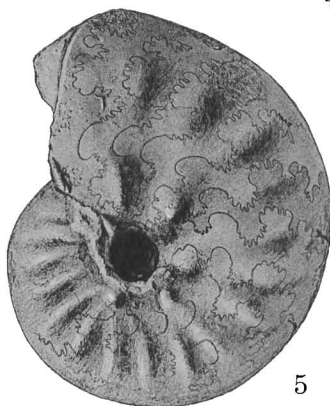




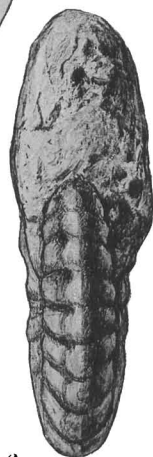


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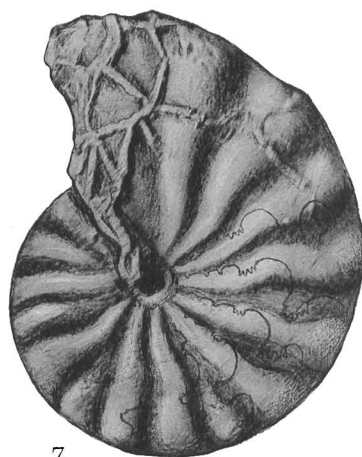
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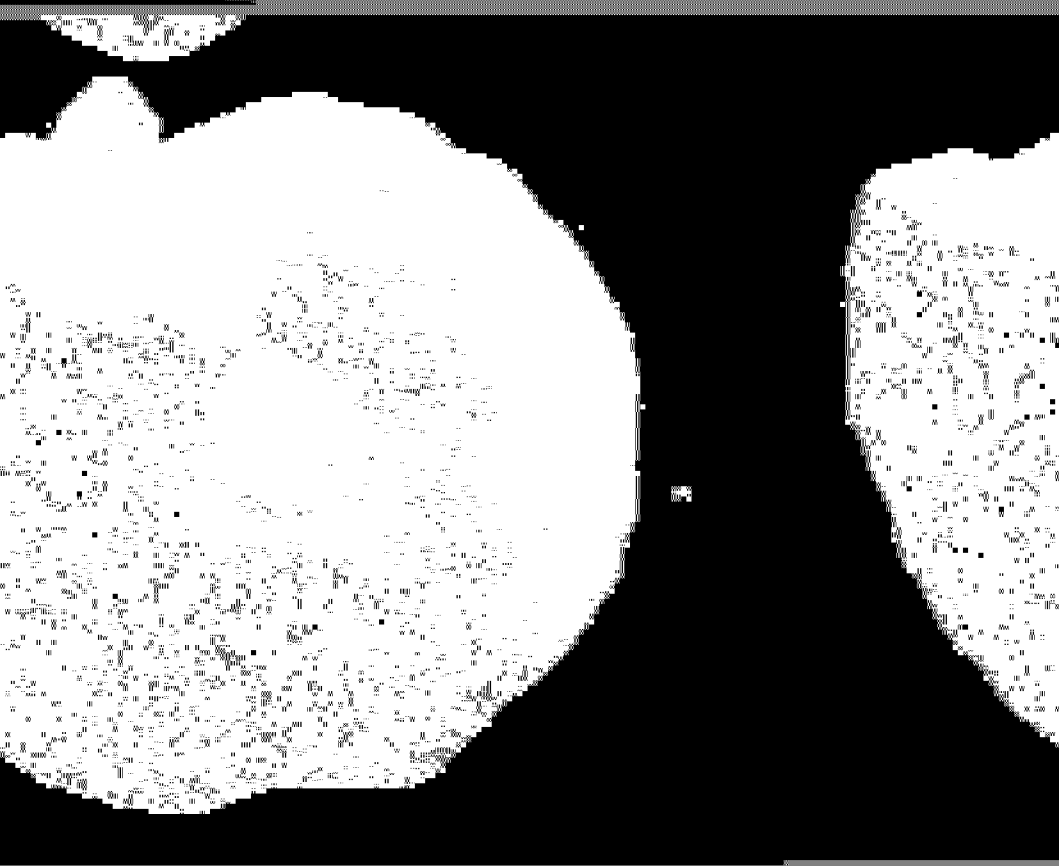


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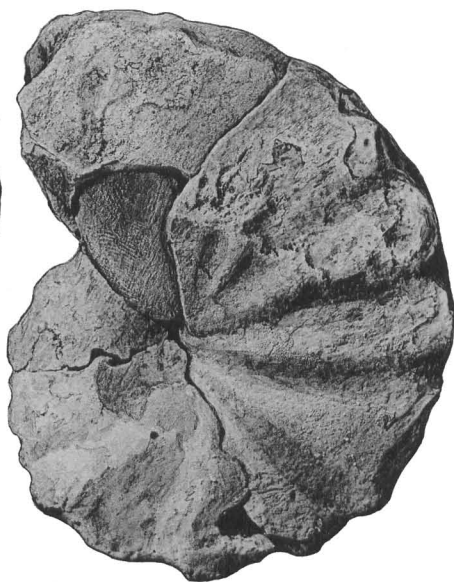




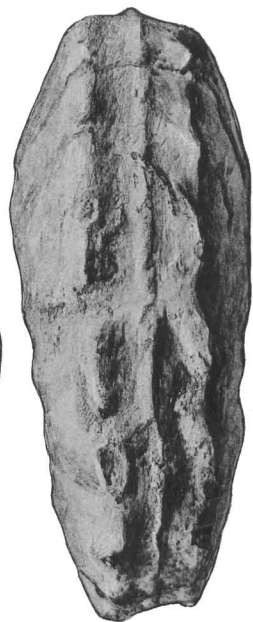




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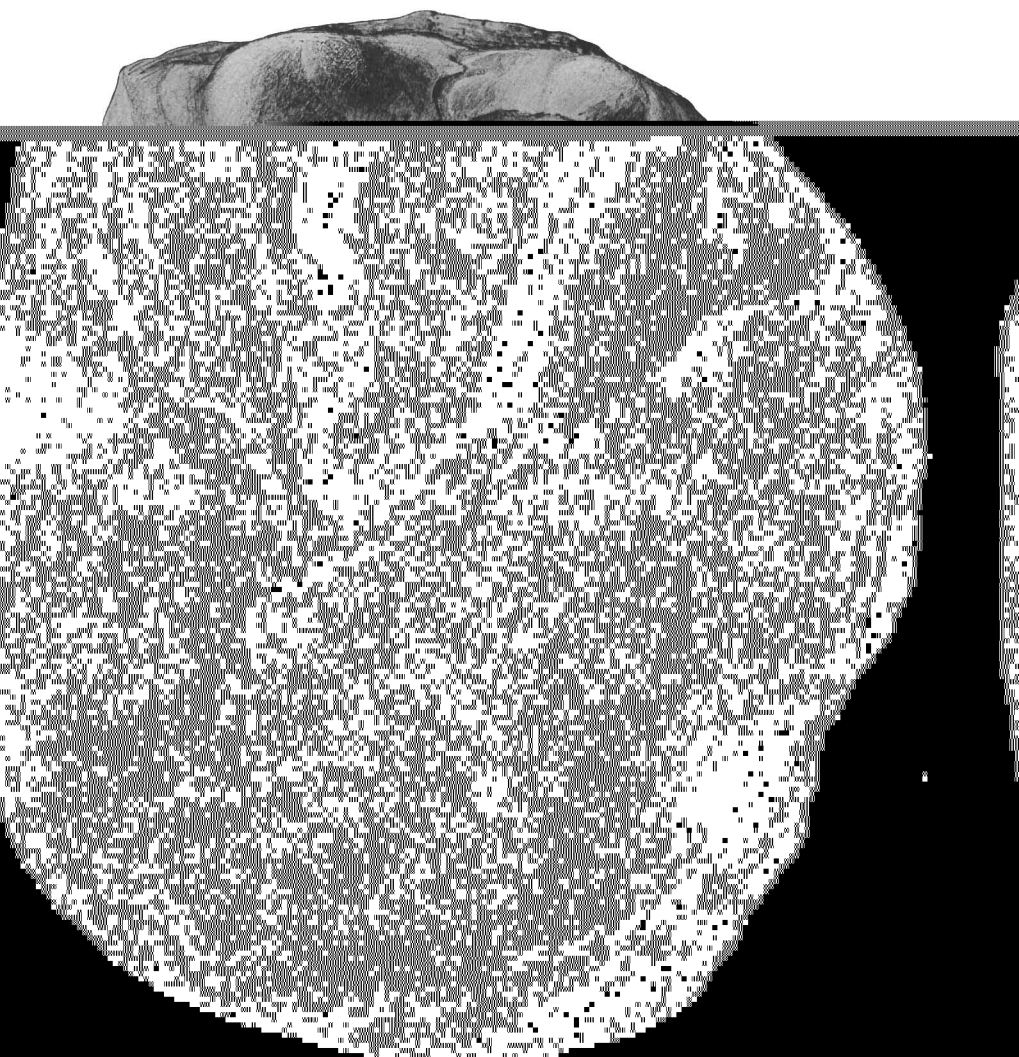


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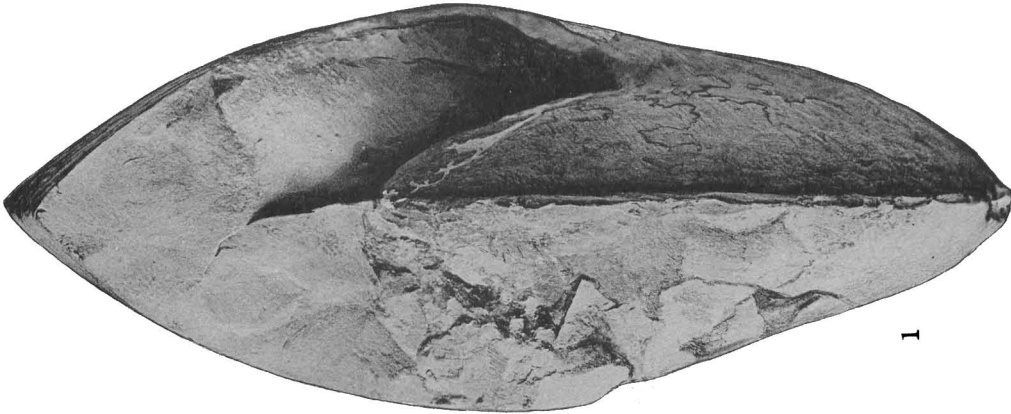








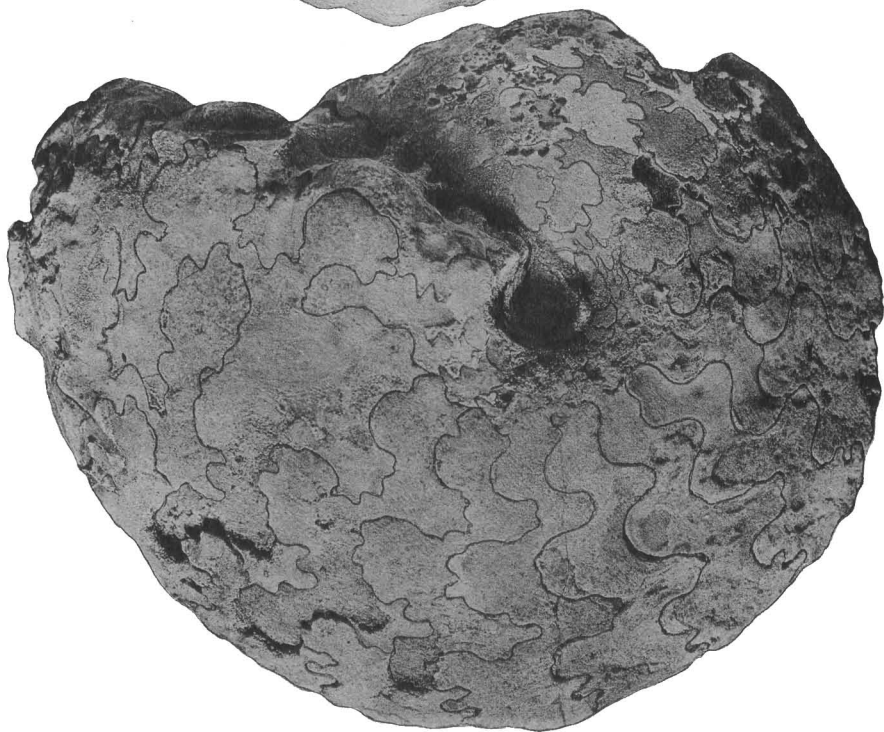
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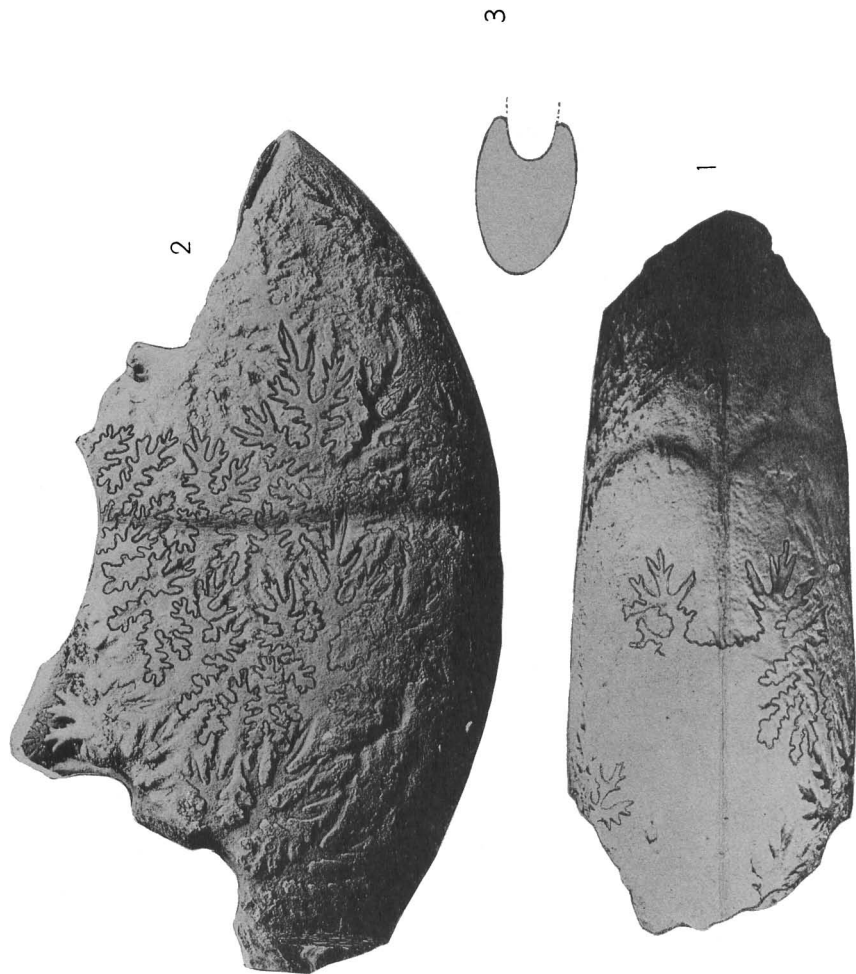
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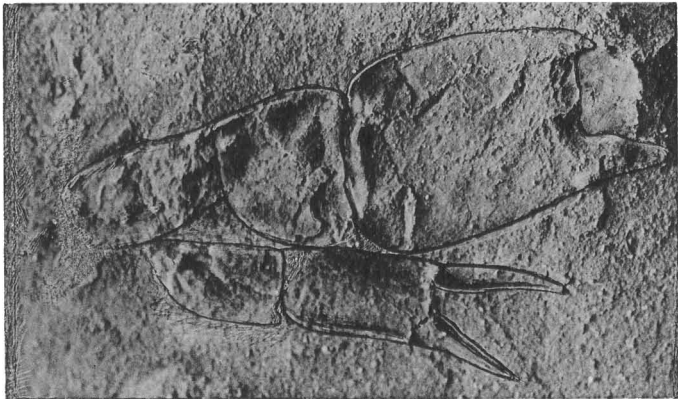


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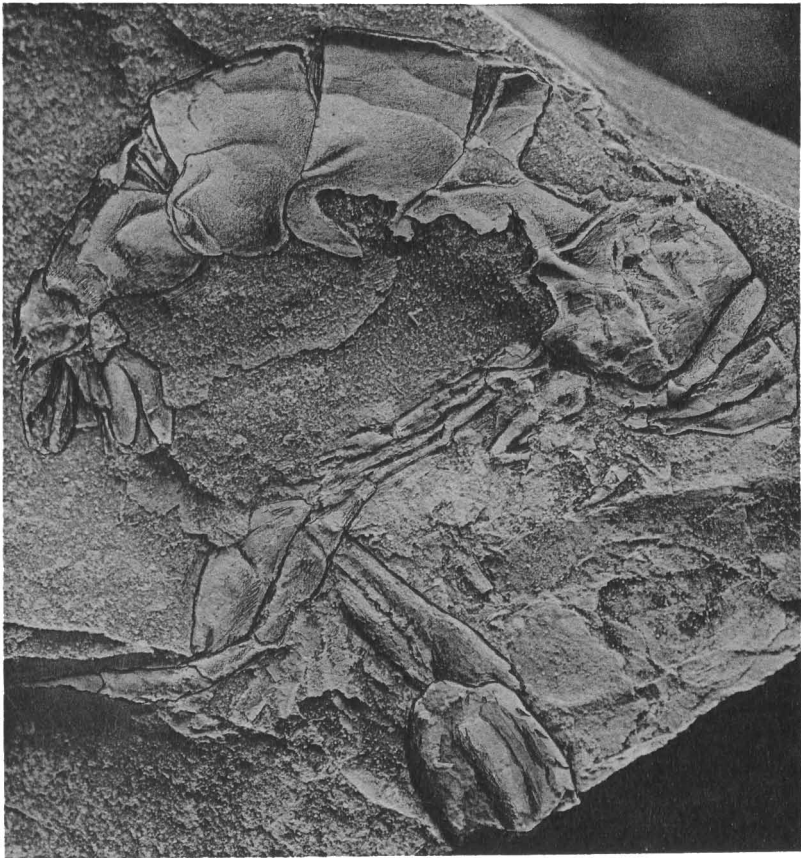


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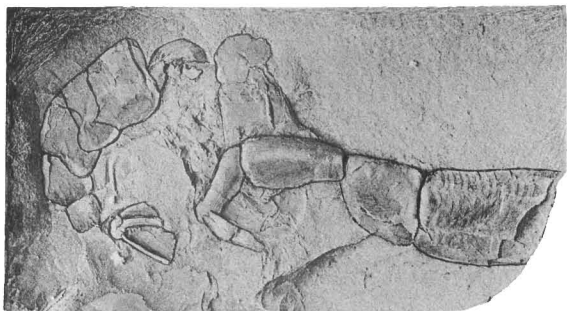




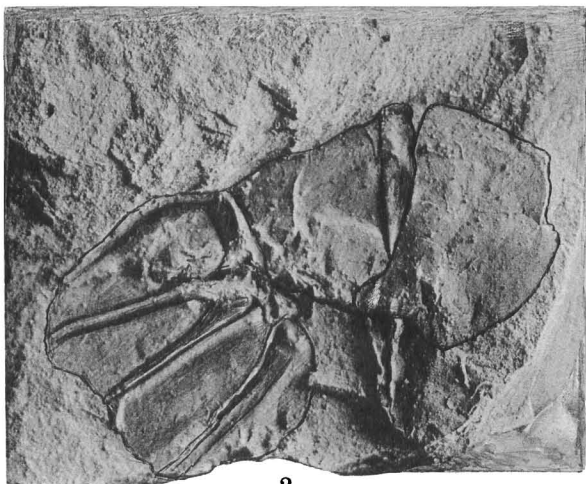
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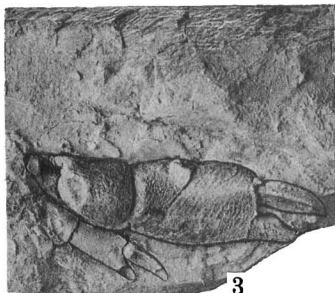
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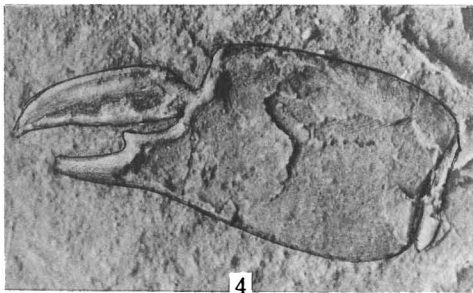
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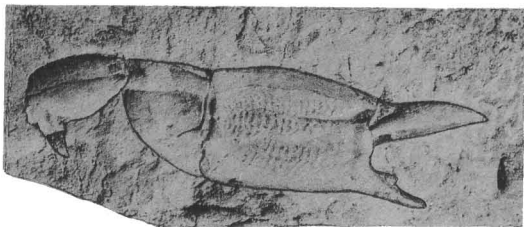
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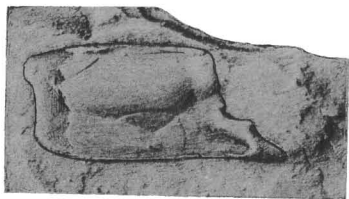
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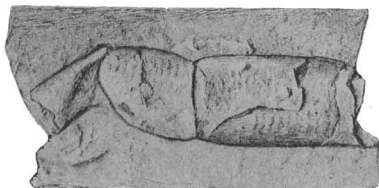
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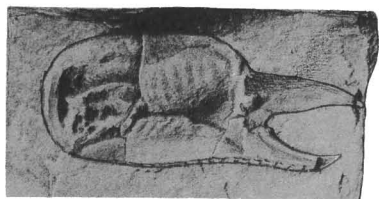
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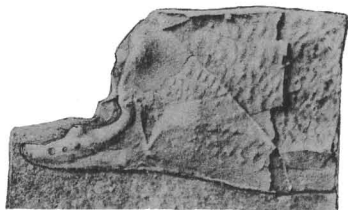
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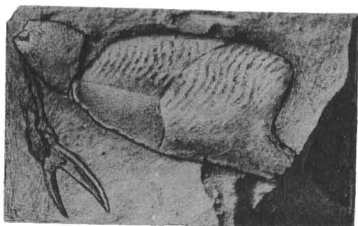
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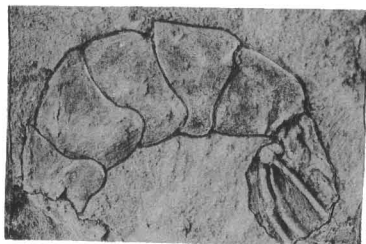
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6



7



8